ECG-9620L
ECG-9620M
ECG-9620N
ECG-9620P
ECG-9620S
ECG-9620T
ECG-9620U

SERVICE MANUAL

cardiofax
ELECTROCARDIOGRAPH

ECG-9620

08CK2.782.00516E

NIHON KOHDEN

Contents

GENERAL HANDLING PRECAUTIONS i
WARRANTY POLICY ii
EMC RELATED CAUTION iii
Conventions Used in this Manual and Instrument iv
Dangers, Warnings, Cautions and Notes iv
Explanations of the Symbols in this Manual and Instrument v

Section 1 General 1C.1
Introduction 1.1
General Information on Servicing 1.2
Service Policy, Service Parts and Patient Safety Checks 1.4
Service Policy 1.4
Service Parts 1.4
Patient Safety Checks 1.5
Maintenance Equipments and Tools 1.5
General Safety Information 1.6
Specifications 1.11
Panel Descriptions 1.14
Front Panel 1.14
Left Side Panel 1.14
Operation Panel 1.15
Right Side Panel 1.15
Rear Panel 1.16
Composition 1.17
Standard Components 1.17
Options 1.17
Location 1.18

Section 2 Maintenance 2C.1
Replacement 2.1
Periodic Replacement Schedule 2.1
Cleaning and Lubrication 2.2
Cleaning and Greasing Schedules 2.2
Cleaning the Paper Mark Sensor and Paper Empty Sensor 2.2
Cleaning the Motor Rotation Sensor and Lubricating the Motor Gear and Gear Meshed with Motor Gear 2.3
Maintenance Check Sheet 2.5

Section 3 Troubleshooting and System Error Message 3C.1
Troubleshooting Flowchart 3.1
Troubleshooting Table 3.4
Troubleshooting General Operation Problem 3.4

Troubleshooting Recording Problem 3.6
System Error Message 3.7

Section 4 System Test, Adjustment and Setting 4C.1
System Test 4.1
Overall 4.1
Calling up the System Test Level 1 ..... 4.2
Calling up the System Test Level 2 ..... 4.3
Entering the System Test Number 4.4
Executing the System Test 4.5
Quitting the System Test 4.6
Exiting the System Test Mode 4.6
Demonstration 4.7
Recorder 4.8
Thermal Head 4.10
Key 4.11
Memory 4.12
Single Memory Test Mode 4.13
Continuous Memory Test Mode 4.13
LCD/LED 4.14
Input Unit 4.16
Calibration 4.17
Communication 4.18
CRO/EXT1 ..... 4.20
System Setup Initialization 4.22
ECG Findings List Recording 4.23
Recording Resolution Setting 4.24
Date and Time Setting 4.25
Setting the Date and Time 4.25

Section 5 Board/Unit Description 5C.1
Block Diagram 5.1
Power Unit 5.2
ECG Control Board 5.2

Section 6 Disassembly 6C.1
Before You Begin 6.1
Warnings and Cautions 6.1
Required Tools 6.1
Cable Connection 6.2
Removing the Upper Casing 6.4
Removing the Magazine and Recording Paper 6.4
Removing the Battery Pack 6.4
Removing the Upper Casing 6.4
Removing the Thermal Head and Motor Assy 6.5
Removing the Thermal Head 6.5

Removing the Motor Assy 6.6
Removing the ECG Control Board 6.6
Removing the Power Board 6.8
Removing the Power Board 6.8
Replacing the Power Fuse and Battery Fuse 6.9
Removing the Key Board and LCD Unit 6.10

Section 7 Replaceable Parts List 7C.1
Instrument 7.2

Section 8 Connector Pin Assignment 8.1
Attaching the Ferrite Core 8.1
EXT-IN Connector 8.2
CRO-OUT Connector 8.2
SIO Connector 8.2

GENERAL HANDLING PRECAUTIONS

This device is intended for use only by qualified medical personnel.
Use only Nihon Kohden approved products with this device. Use of non-approved products or in a non-approved manner may affect the performance specifications of the device. This includes, but is not limited to, batteries, recording paper, pens, extension cables, electrode leads, input boxes and AC power.

Please read these precautions thoroughly before attempting to operate the instrument.

1. **To safely and effectively use the instrument, its operation must be fully understood.**

2. **When installing or storing the instrument, take the following precautions:**
   (1) Avoid moisture or contact with water, dust, extreme atmospheric pressure, excessive humidity and temperatures, poorly ventilated areas, and saline or sulphuric air.
   (2) Place the instrument on an even, level floor. Avoid vibration and mechanical shock, even during transport.
   (3) Avoid placing in an area where chemicals are stored or where there is danger of gas leakage.
   (4) The power line source to be applied to the instrument must correspond in frequency and voltage to product specifications, and have sufficient current capacity.
   (5) Choose a room where a proper grounding facility is available.

3. **Before Operation**
   (1) Check that the instrument is in perfect operating order.
   (2) Check that the instrument is grounded properly.
   (3) Check that all cords are connected properly.
   (4) Pay extra attention when the instrument is in combination with other instruments to avoid misdiagnosis or other problems.
   (5) All circuitry used for direct patient connection must be doubly checked.
   (6) Check that battery level is acceptable and battery condition is good when using battery-operated models.

4. **During Operation**
   (1) Both the instrument and the patient must receive continual, careful attention.
   (2) Turn power off or remove electrodes and/or transducers when necessary to assure the patient's safety.
   (3) Avoid direct contact between the instrument housing and the patient.

5. **To Shutdown After Use**
   (1) Turn power off with all controls returned to their original positions.
   (2) Remove the cords gently; do not use force to remove them.
   (3) Clean the instrument together with all accessories for their next use.

6. **The instrument must receive expert, professional attention for maintenance and repairs. When the instrument is not functioning properly, it should be clearly marked to avoid operation while it is out of order.**

7. **The instrument must not be altered or modified in any way.**

8. **Maintenance and Inspection:**
   (1) The instrument and parts must undergo regular maintenance inspection at least every 6 months.
   (2) If stored for extended periods without being used, make sure prior to operation that the instrument is in perfect operating condition.

(3) Technical information such as parts list, descriptions, calibration instructions or other information is available for qualified user technical personnel upon request from your Nihon Kohden distributor.

9. **When the instrument is used with an electrosurgical instrument, pay careful attention to the application and/or location of electrodes and/or transducers to avoid possible burn to the patient.**

10. **When the instrument is used with a defibrillator, make sure that the instrument is protected against defibrillator discharge. If not, remove patient cables and/or transducers from the instrument to avoid possible damage.**

WARRANTY POLICY

Nihon Kohden Corporation (NKC) shall warrant its products against all defects in materials and workmanship for one year from the date of delivery. However, consumable materials such as recording paper, ink, stylus and battery are excluded from the warranty.

NKC or its authorized agents will repair or replace any products which prove to be defective during the warranty period, provided these products are used as prescribed by the operating instructions given in the operator's and service manuals.

No other party is authorized to make any warranty or assume liability for NKC's products. NKC will not recognize any other warranty, either implied or in writing. In addition, service, technical modification or any other product change performed by someone other than NKC or its authorized agents without prior consent of NKC may be cause for voiding this warranty.

Defective products or parts must be returned to NKC or its authorized agents, along with an explanation of the failure. Shipping costs must be pre-paid.

This warranty does not apply to products that have been modified, disassembled, reinstalled or repaired without Nihon Kohden approval or which have been subjected to neglect or accident, damage due to accident, fire, lightning, vandalism, water or other casualty, improper installation or application, or on which the original identification marks have been removed.

EMC RELATED CAUTION

This equipment and/or system complies with the International Standard IEC60601-1-2 for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in the IEC60601-1-2, can cause harmful interference to the equipment and/or system or cause the equipment and/or system to fail to perform its intended function or degrade its intended performance. Therefore, during the operation of the equipment and/or system, if there is any undesired deviation from its intended operational performance, you must avoid, identify and resolve the adverse electromagnetic effect before continuing to use the equipment and/or system.

The following describes some common interference sources and remedial actions:

1. **Strong electromagnetic interference from a nearby emitter source such as an authorized radio station or cellular phone:**
   Install the equipment and/or system at another location if it is interfered with by an emitter source such as an authorized radio station. Keep the emitter source such as cellular phone away from the equipment and/or system.

2. **Radio-frequency interference from other equipment through the AC power supply of the equipment and/or system:**
   Identify the cause of this interference and if possible remove this interference source. If this is not possible, use a different power supply.

3. **Effect of direct or indirect electrostatic discharge:**
   Make sure all users and patients in contact with the equipment and/or system are free from direct or indirect electrostatic energy before using it.

4. **Electromagnetic interference with any radio wave receiver such as radio or television:**
   If the equipment and/or system interferes with any radio wave receiver, locate the equipment and/or system as far as possible from the radio wave receiver.

If the above suggested remedial actions do not solve the problem, consult your Nihon Kohden Corporation subsidiary or distributor for additional suggestions.

The CE mark is a protected conformity mark of the European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.

The CE mark is applied only to the ECG-9620L/M/N Electrocardiograph.

This equipment complies with EUROPEAN STANDARD EN-60601-1-2 (1993) which requires EN-55011, class B.

Conventions Used in this Manual and Instrument

Dangers, Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

DANGER

A danger is used to alert the user to a hazardous situation which will cause death or serious injury.

WARNING

A warning alerts the user to possible injury or death associated with the use or misuse of the instrument.

CAUTION

A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.

NOTE

A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.

Explanations of the Symbols in this Manual and Instrument

The following symbols found in this manual/instrument bear the respective descriptions as given.

Cardiograph

Symbol	Description	Symbol	Description
	Attention, consult operator's manual		Type CF applied part
	Equipotential terminal		Serial number
	Serial input/output terminal		Date of manufacture
	Input terminal for analog signal		The CE mark is a protected conformity mark of European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.
	Output terminal for analog signal		
	Eject (magazine release button)		Protective earth
	Alternative current		

The CE mark is applied only to the ECG-9620L/M/N Electrocardiograph.

Patient cable

Symbol	Description	Symbol	Description
	Attention, consult operator's manual		The CE mark is a protected conformity mark of European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.
	Defibrillation-proof Type CF applied par		

Operation panel

Symbol	Description	Symbol	Description
	Alternating current	5	Rhythm
	“On” only for a part of equipment	6	Age
	“Off” only for a part of equipment	7	Sex
	Battery charging	8	Paper feed / Mark
	Battery check	9	Filter
0	Copy / Calibration		Automatic / Manual control
F1 1	F1 function key	CLR	Clear
F2 2	F2 function key		Start/Stop recording
F3 3	F3 function key	ENT	Enter
4	Mode		

A key with a numeric number is used to enter numbers in the System Setup screen and paient information.

On screen

Symbol	Description
	QRS sync mark
	CAL mark

Section 1 General

Introduction 1.1
General Information on Servicing 1.2
Service Policy, Service Parts and Patient Safety Checks 1.4
- Service Policy 1.4
- Service Parts 1.4
- Patient Safety Checks 1.5
- Maintenance Equipments and Tools 1.5

General Safety Information 1.6
Specifications 1.11
Panel Descriptions 1.14
- Front Panel 1.14
- Left Side Panel 1.14
- Operation Panel 1.15
- Right Side Panel 1.15
- Rear Panel 1.16

Composition 1.17
- Standard Components 1.17
- Options 1.17

Location 1.18

Introduction

This service manual provides useful information to qualified service personnel to understand, troubleshoot, service, maintain and repair the ECG-9620L/M/N/P/S/T/U Electrocardiograph (referred to as “the instrument” in this service manual).

The System test, Adjustment and Setting section in this service manual describes the maintenance that should be performed by qualified service personnel. The Maintenance section in the operator’s manual describes the maintenance that can be performed by the user.

The information in the operator’s manual is primarily for the user. However, it is important for service personnel to thoroughly read the operator’s manual and service manual before starting to troubleshoot, service, maintain or repair this instrument. This is because service personnel need to understand the operation of the instrument in order to effectively use the information in the service manual.

General Information on Servicing

Note the following information when servicing the instrument.

CAUTIONS

Safety

- **There is the possibility that the outside surface of the instrument, such as the operation keys, could be contaminated by contagious germs, so disinfect and clean the instrument before servicing it. When servicing the instrument, wear rubber gloves to protect yourself from infection.**

- **There is the possibility that when the lithium battery is broken, a solvent inside the lithium battery could flow out or a toxic substance inside it could come out. If the solvent or toxic substance touches your skin or gets into your eye or mouth, immediately wash it with a lot of water and see a physician.**

Liquid ingress

The instrument is not waterproof, so do not install the instrument where water or liquid can get into or fall on the instrument. If liquid accidentally gets into the instrument or the instrument accidentally drops into liquid, disassemble the instrument, clean it with clean water and dry it completely. After reassembling, verify that there is nothing wrong with the patient safety checks and function/ performance checks. If there is something wrong with the instrument, contact your Nihon Kohden representative for repair.

Environmental Safeguards

Depending on the local laws in your community, it may be illegal to dispose of the lithium battery in the regular waste collection. Check with your local officials for proper disposal procedures.

Disinfection and cleaning

To disinfect the outside surface of the instrument, wipe it with a non-abrasive cloth moistened with alcohol. Do not use any other disinfectants or ultraviolet rays to disinfect the instrument.

Caution - continued

Transport

- **Use the specified shipment container and packing material to transport the instrument. If necessary, double pack the instrument. Also, put the instrument into the shipment container after packing so that the buffer material does not get inside the instrument.**
- **When transporting a board or unit of the instrument, be sure to put it in a conductive bag. Never use an aluminum bag to transport a board or unit. Also, never use a styrene foam or plastic bag which generates static electricity to wrap the board or unit of the instrument.**

Handling the instrument

- **Because the outside surface of the instrument is made of resin, the outside surface of the instrument is easily damaged. So when handling the instrument, remove clutter from around the instrument and be careful to not damage the instrument or get it dirty.**
- **Because most of the boards in the instrument are multilayer boards with surface mount electrical devices (SMD), a special tool is required to remove and solder the electrical devices on it. To avoid damaging other electrical components, do not remove and solder SMD components yourself.**

Measuring and Test Equipment

Maintain the accuracy of the measuring and test equipment by checking and calibrating it according to the check and calibration procedures.

Service Policy, Service Parts and Patient Safety Checks

Service Policy

Our technical service policy for this instrument is to replace the faulty unit, board or part or damaged mechanical part with a new one. Do not perform electrical device or component level repair of the multilayer board or unit. We do not support component level repair outside the factory for the following reasons:

- Most of the boards are multilayer boards with surface mount electrical devices, so the mounting density of the board is too high.
- A special tool or high degree of repair skill is required to repair the multilayer boards with surface mount electrical devices.

Only disassemble the instrument or replace a board or unit in an environment where the instrument is protected against static electricity.

Service Parts

Refer to “Replaceable Parts List” of this manual for the service parts for technical service that we provide.

NOTE

When ordering parts or accessories from your Nihon Kohden representative, please quote the NK code number and part name which is listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use parts and accessories recommended or supplied by Nihon Kohden Corporation to assure maximum performance from your instrument.

Patient Safety Checks

Periodic maintenance procedures and diagnostic check procedures are provided in this manual to ensure that the instrument is operating in accordance with its design and production specifications. To verify that the instrument is working in a safe manner with regard to patient safety, patient safety checks should be performed on the instrument before it is first installed, periodically after installation, and after any repair is made on the instrument.

For patient safety checks, perform the following checks as described in the IEC60601-1 “Medical electrical equipment - Part 1: General requirements for safety”:

- Protective earth resistance check
- Earth leakage current check
- Enclosure leakage current check
- Patient leakage current check
- Withstanding voltage check

Maintenance Equipments and Tools

Test equipment

When repairing or calibrating the instrument, the following test equipment is required.

- Oscilloscope: 2 channels or more for input signal, 50 mV to 5 V input range, 1/10 attenuating probe and 100 MHz or more frequency response characteristic must be provided.
- Digital voltmeter: standard type (An oscilloscope can be used instead of the digital voltmeter.)

General Safety Information

DANGER

- **Never use this cardiograph in the presence of any flammable anesthetic gas or high-concentration oxygen atmosphere. Failure to follow this warning may cause explosion or fire.**

- **Never use this cardiograph in a high-pressure oxygen medical tank. Failure to follow this warning may cause explosion or fire.**

WARNING

Using with an electrical surgical unit (ESU)

- **Never use this cardiograph near an ESU. The cardiograph may malfunction due to high-frequency noise from the ESU.**
- **When using this cardiograph with an ESU, refer to the instruction manual for the ESU. Before measurement, check that the return plate is correctly attached to the patient and check that the cardiograph operates correctly when using with the ESU. If the return plate is not attached correctly, it may burn the patient's skin where the electrodes are attached.**

MRI examination

- **Do not install this cardiograph in an MRI examination room. The cardiograph may not operate properly due to high-frequency magnetic noise from the MRI.**
- **When performing MRI tests, remove from the patient all electrodes which are connected to this cardiograph. Failure to follow this warning may cause serious electrical burn on the patient due to local heating caused by dielectric electromotive force. For details, refer to the instruction manual for the MRI.**

When performing defibrillation

- **Before defibrillation, remove all electrodes and gel from the chest of the patient. If the defibrillator paddle touches electrodes or gel, the discharged energy may burn the patient's skin.**
- **Before defibrillation, all persons must keep clear of the bed and must not touch the patient or any equipment connected to the patient. Failure to follow this warning may cause serious electrical burn, shock or other injury.**

Warning - continued

Use only the following specified patient cables when using with a defibrillator or ESU. When the specified patient cable is connected, the cardiograph is type CF defibrillation-proof compliance. Failure to follow this warning will cause serious electrical burn where the electrode is attached and damage the cardiograph due to discharge energy when defibrillation is performed.

Patient cable: BJ-901D – IEC standard, 3 mm diameter tip
BJ-902D – IEC/DIN standard, 4 mm diameter tip
BJ-903D – IEC/DIN standard, clip
BA-901D – AHA requirement, 3 mm diameter tip
BA-903D – AHA requirement, color clip

When using an ESU and defibrillator with the cardiograph, use silver chloride disposable electrodes.

Installation

WARNING

- **Only use the 3-prong power cord provided with the cardiograph. Failure to follow this caution may cause electrical shock to the patient and operator.**
- **Only use the specified patient cable and connect the external instruments with the specified installation procedure. Failure to follow this warning may cause a serious electrical shock to the patient and operator by leakage current.**

CAUTION

- **When the provided 3-prong power cord cannot be used, operate the cardiograph on battery power. When another type of power cord (especially 2-prong power cord) is used, this may cause electrical shock to the patient and operator.**
- **When several medical instruments are used together, ground all instruments at the same one-point ground to protect the patient and operator from electrical shock. Any potential difference between instruments may cause electrical shock to the patient and operator.**
- **When connecting an external instrument to connectors marked with ⚠, the external instrument and this cardiograph must be connected according to the IEC60601-1-1 “Medical electrical equipment - Part 1-1: General requirements for safety - Collateral standard: Safety requirements for medical electrical systems”. Failure to follow this warning may cause electrical shock to the patient and operator.**
- **When inserting or removing the battery from the cardiograph, make sure that the cardiograph is turned off. Otherwise, the patient and operator may get an electrical shock.**

Battery Pack

DANGER

- **Keep the battery pack away from fire. Do not heat the battery pack. Otherwise, the substance liquid leaks out and the battery pack explodes.**
- **Never short-circuit the + and – terminals on the battery pack with a wire. Never store or carry the battery pack with metal such as necklace or hair pins. The battery pack short-circuits and a large current flows, causing leakage of the substance liquid inside the battery and battery explosion.**
- **Never disassemble or modify the battery pack. Never damage or directly solder the sheath tube. The battery pack short-circuits, the substance liquid comes out and the battery pack explodes.**
- **Do not use a battery pack which is damaged, such as from falling. There is a gas discharge valve inside the battery and if this valve is damaged, the gas cannot be discharged, causing the battery pack to explode.**
- **Do not subject the battery pack to a strong mechanical shock. The susbstance liquid inside the battery leaks and explodes.**
- **If the battery pack is damaged and substance liquid inside the battery contacts the eyes or skin, wash immediately and thoroughly with water and see your physician. Never rub your eyes, otherwise you may lose your eyesight.**
- **Only charge the battery pack with the ECG-9620 cardiograph. If any other battery charger is used, abnormal current flows and the substance liquid inside the battery leaks and the battery explodes.**
- **Do not connect the battery pack to an AC outlet or lighter socket in a car. The substance liquid inside the battery leaks out and the battery pack explodes.**
- **The battery has + and – polarity. Make sure that the battery is installed with the correct polarity direction. Otherwise, the substance inside the battery leaks out and the battery pack explodes.**
- **Use only the SB-901D battery pack.**

WARNING

- **Do not immerse the battery pack in water or seawater. The battery heats up and rusts and the substance liquid inside the battery leaks.**
- **Never use a battery pack which is damaged, discolored or has leakage. A damaged battery pack explodes if used.**
- **Do not leave the battery pack unused for more than one year. The battery may leak.**

CAUTION

- **Do not charge the deteriorated battery pack. Otherwise, the cardiograph cannot operate on battery power.**
- **Do not expose the battery pack to direct sunlight or leave in a high temperature place. The life time of the battery pack may be shortened, the performance of the battery pack may be degraded and the substance liquid inside the battery may leak.**
- **Do not leave the battery pack where patients can reach it.**
- **Before disposing of the battery pack, check with your local solid waste officials for details in your area for recycling options or proper disposal. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream.**

Operation

CAUTION

- **Enter the patient information correctly. Otherwise, the ECG data may be lost or mixed up with another patient's ECG data.**

ECG recording judgement

- **The cardiograph provides automatic ECG analysis function. The automatic ECG analysis is performed for acquired ECG waveforms only and does not reflect all conditions of the patient. The results of the analysis may not correspond to the judgment of a physician.**
- **Overall judgement must be performed by the physician, referring to the analysis result, clinical findings, and other examination results. After the physician's overall judgement, the analysis results should be signed or initialed by the physician.**
- **Take care when judging the ECG recording because the 25 Hz EMG filter may cause greater distortion of P-waves and QRS-waves depending on the waveform shape. The characteristics of the EMG filter are similar to a conventional analog filter.**

- **Do not use the output signal from the output connector for a synchronization signal such as the synchronized cardioversion signal. There is a time delay between the input ECG signal and output signal.**
- **When the cardiograph operates on battery power and large leakage current is input from the connected external instrument, ground the cardiograph or use an isolation transformer for the external instrument. Failure to follow this caution may cause electrical shock to patient and operator.**
- **Use only the KD-103E cart for the cardiograph. When another cart is used, the cardiograph may fall off or the cart may tip over.**

Caution - continued

- **Never use the cardiograph with its side panel downward. Failure to follow this caution may cause the cardiograph to fall over or cause battery liquid leakage.**

NOTE

- **When using the battery pack and the battery operation lamp is blinking in orange, measurement results may not be saved.**

Maintenance

CAUTION

- **Before maintenance (cleaning, disinfection), make sure that the cardiograph is turned off and the power cord is removed from the AC outlet and cardiograph. Otherwise, the operator may get an electrical shock and the cardiograph may malfunction.**
- **Before battery replacement, make sure that the cardiograph is turned off and the power cord is removed from the AC outlet and cardiograph. Otherwise, the operator may get an electrical shock.**
- **Do not disassemble or repair the cardiograph. Disassembly and repair must be performed by qualified service personnel.**

Specifications

ECG input

Input impedance	10 MΩ or more
Electrode offset tolerance	±500 mV or more
Input unit protection	Isolated and defibrillator protected only when the following specified patient cable is connected Patient cable: BJ-901D, BJ-902D, BJ-903D, BA-901D, BA-903D
Standard sensitivity	10 mm /mV ±2%
Common mode rejection ratio	100 dB or more
Frequency response	0.05 to 150 Hz – 3 dB or more

Waveform data processor

Sample rate	500 samples/s (input unit: 8,000 samples/s)
AC line filter	50/60 Hz
High-cut filter	75, 100, 150 Hz
EMG filter	25/35 Hz
Time constant	3.2 s or more
Waveform status detection	Electrode detachment (polarization voltage), Noise (high frequency)
Sensitivity selection	5, 10 , 20 mm/mV

LCD

Size	3.8 inch
Number of dots	320 × 240
ECG waveform	6 channel: 2.8 s
Displayed data	Waveform, patient information, recording settings, operation mode, heart rate, QRS sync mark, error message, electrode detachment, noise

Recorder

Printing method	High resolution thermal printer head
Printing density	200 dpi (8 dots/mm)
Scanning line density	1 ms
Recording width	56 mm
Number of recording channels	1, 2, 3
Paper speed	25, 50 mm/s
Number of recording lines	Up to 14
Printed data	Program type, version, date and time, paper speed, sensitivity, lead name, filter, Patient information (ID number, sex, age zone), timing mark, event mark, electrode detachment, noise
Mechanical noise	48 dB or less at paper speed 25 mm/s

External input/output

External input	10 mm/0.5 V ±5%, input impedance 100 kΩ or more	
Signal output	0.5 V/1 mV ±5%, output impedance 100 Ω or less	
Serial I/O	Communication method:	RS-232C
	Baud rate:	2400, 4800, 9600, 19200, 38400, 57600, 115200

Power requirement

Line voltage	ECG-9620L:	220 V AC ±10%
	ECG-9620M:	230 V AC ±10%
	ECG-9620N:	240 V AC ±10%
	ECG-9620P:	220 V AC ±10%
	ECG-9620S:	110 V AC ±10%
	ECG-9620T:	120 V AC ±10%
	ECG-9620U:	127 V AC ±10%
Line frequency	50 or 60 Hz	
Power input	45 VA	
Power consumption	45 W or less	
Built-in battery (SB-901D)	Voltage: 12 V	
	Current consumption:	6 A or less
	Battery operation time:	2 hours or more (when using a new fully charged battery in manual mode, at 25 mm/s of recording speed, 3 ch, and in continuous recording.) Remaining battery power can change depending on the surrounding temperature and quality of recording waveform.

Environment

Operating temperature	5 to 40°C (41 to 104°F)	
Operating humidity		
	25 to 85% RH (with battery pack and recording paper)	
	20 to 85% RH (with battery pack and without recording paper)	
	25 to 90% RH (with recording paper and without battery pack)	
	25 to 95% RH (without battery pack and recording paper)	
Operating atmospheric pressure	70 to 106 kPa	
Storage temperature		
	Cardiograph:	-20 to 65°C (–4 to 149°F)
	Battery pack:	-20 to 50°C (–4 to 122°F) (within 30 days)
		-20 to 40°C (–4 to 104°F) (within 90 days)
		-20 to 30°C (–4 to 86°F) (within one year)
	Recording paper:	-20 to 50°C (–4 to 122°F)
Storage humidity		
	Cardiograph:	10 to 95% RH (non-condensing)
	Battery pack:	10 to 85% RH (non-condensing) (within 60 days)
		45 to 85% RH (non-condensing) (more than 60 days)
	Recording paper:	10 to 90% RH (non-condensing)
Storage atmospheric pressure	70 to 106 kPa	

Electromagnetic compatibility

IEC60601-1-2 (1993), CISPR11 (1990) Group 1 Class B

IEC60601-2-25 Amendment 1 (1999), protection against electrosurgery interference

Other

Indoor portable

Dimensions and weight

Dimensions	280 W × 70 H × 216 D mm (excluding protrusions)
Weight	Approx. 3.1 kg (with battery)
	Approx. 2.7 kg (without battery)

Safety

Safety standard:

IEC60601-1 (1998)
IEC60601-1 Amendment 1 (1991)
IEC60601-1 Amendment 2 (1995)
IEC60601-2-25 (1993)
IEC60601-2-25 Amendment 1 (1999)

Type of protection against electric shock:

AC power: Class I
Battery power: Internally powered equipment

Degree of protection against electric shock:

Defibrillator proof type CF applied part when patient cable BJ-901D, BJ-902D, BJ-903D, BA-901D or BA-903D is used

Degree of protection against harmful ingress of water:

Ordinary equipment

Degree of safety of application in the presence of a flammable anaesthetic mixture with air, oxygen or nitrous oxide:

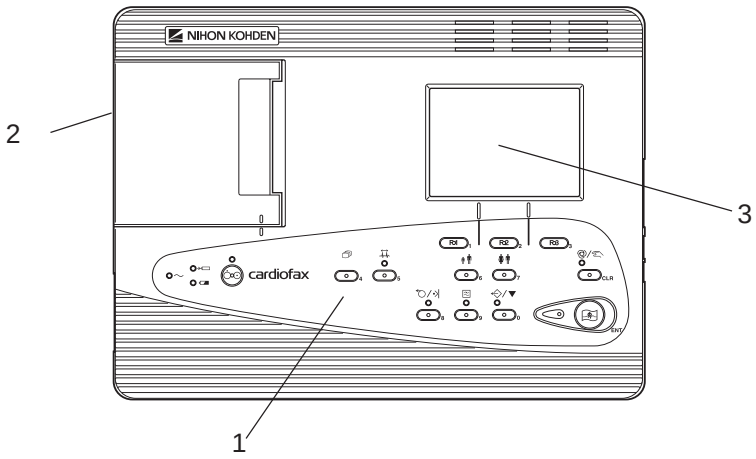
Not suitable for use in the presence of a flammable anaesthetic mixture with air, oxygen or nitrous oxide

Mode of operation:

Continuous

Panel Descriptions

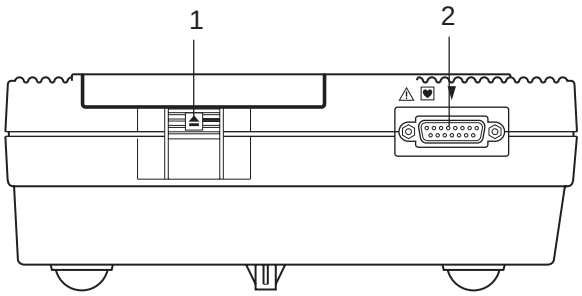
Front Panel



Name

1. Operation panel
2. Magazine (paper container)
3. LCD screen

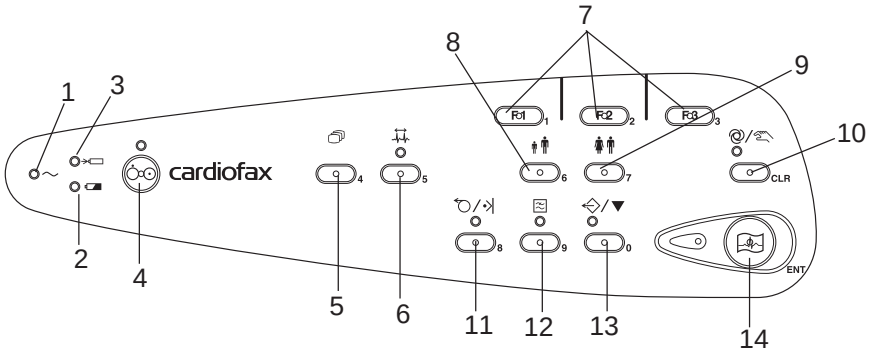
Left Side Panel



Name

1. Magazine release button
2. Patient cable connector

Operation Panel

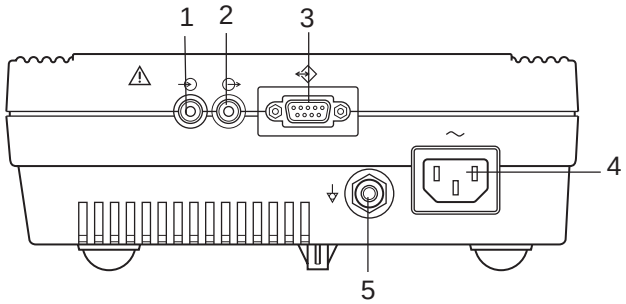


	Name		Name
1.	AC power lamp	8.	Age key
2.	Battery operation lamp	9.	Sex key
3.	Battery charge lamp	10.	Auto/Manual key/lamp
4.	Power key/lamp	11.	Feed/Mark key
5.	Mode key	12.	Filter key/lamp
6	Rhythm key/lamp	13.	Copy/CAL key lamp
7.	F1, F2, F3 function keys	14.	Start/Stop key/lamp

Right Side Panel

CAUTION

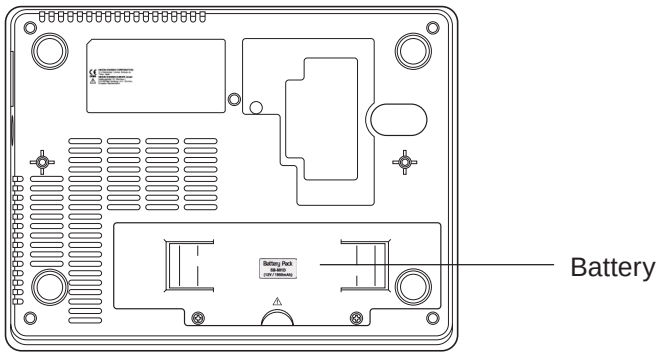
- **When connecting an external instrument to connectors marked with ⚠, the external instrument and this cardiograph must be connected according to the IEC60601-1-1 “Medical electrical equipment - Part 1-1: General requirements for safety - Collateral standard: Safety requirements for medical electrical systems”. Failure to follow this warning may cause electrical shock to the patient and operator.**
- **Do not use the output signal from the output connector for a synchronization signal such as the synchronized cardioversion signal. There is a time delay between the input ECG signal and output signal.**



	Name
1.	EXT-IN connector
2.	CRO-OUT
3.	SIO connector
4.	AC power cord socket
5.	Equipotential ground terminal

Rear Panel

The CE mark is applied only to the ECG-9620L/M/N Electrocardiograph.

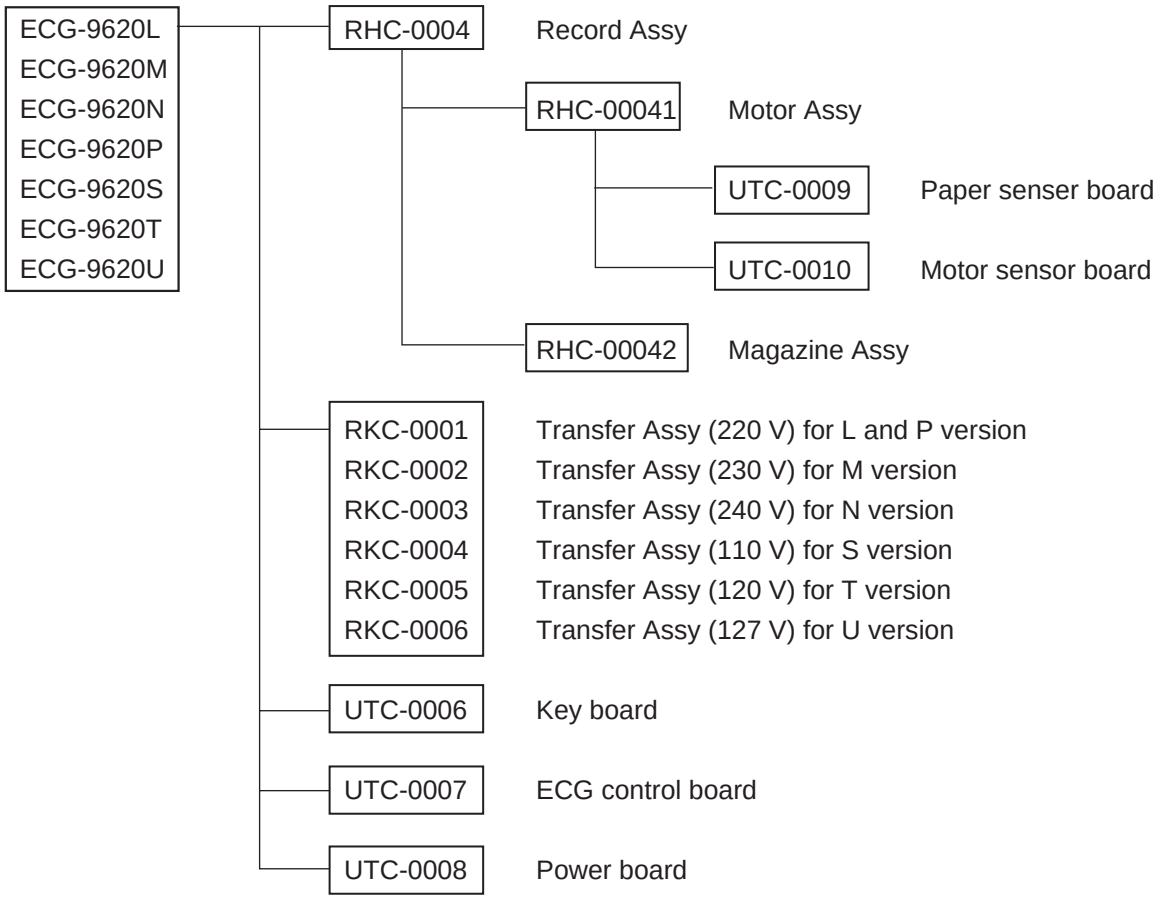


CAUTION

Always install the battery even when the cardiograph operates on AC power. Otherwise sudden power down occurs when any electrode is detached during recording.

Composition

Standard Components

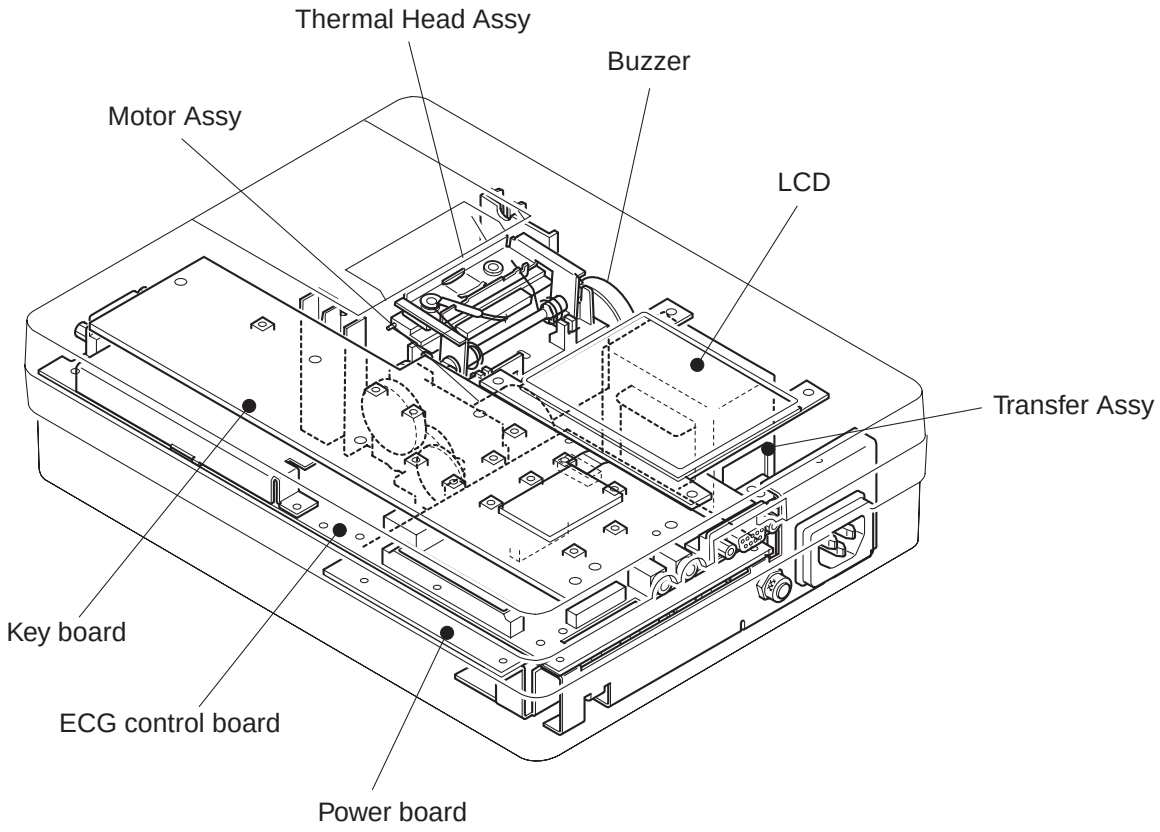


Options

KD-103E	Cart
KH-801E	Patient Cable Hanger

- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to “Section 7 Replaceablet Parts List”.

Location


Thermal Head Assy
Buzzer
Motor Assy
LCD
Transfer Assy
Key board
ECG control board
Power board

Section 2 Maintenance

Replacement 2.1
Periodic Replacement Schedule 2.1
Cleaning and Lubrication 2.2
Cleaning and Greasing Schedules 2.2
Cleaning the Paper Mark Sensor and Paper Empty Sensor 2.2
Cleaning the Motor Rotation Sensor and Lubricating the Motor Gear and Gear Meshed with Motor Gear 2.3
Maintenance Check Sheet 2.5

This section describes the periodic replacement and cleaning of parts which are required to maintain the instrument in good working condition.

Replacement

This subsection only describes replacement schedule for parts that need to be periodically replaced. The actual replacement procedures are described in the section for Disassembly and Assembly. Read the whole “Disassembly and Assembly” section, especially its Warnings and Cautions, before replacing any of the parts described here.

Periodic Replacement Schedule

To maintain the performance of the instrument, the parts listed in the table below must be periodically replaced by qualified service personnel.

Code No.	Description	Recommendation
SB-901D	Battery pack	* See below.
08SK3.878.00046	Thermal head, KYT-56-8MPP1-SKH	After 50 km recording
RHC-00041	Motor Assy	After 1000 hours operation

* Replace the battery pack when it cannot last for 30 minutes during battery operation at the temperatures between 20 and30°C.

Cleaning and Lubrication

This subsection describes the cleaning and lubrication procedures for parts that must be cleaned and lubricated by qualified service personnel. The cleaning procedures for parts that can be cleaned by the user are described in the Operator's Manual.

Cleaning and Lubricating Schedules

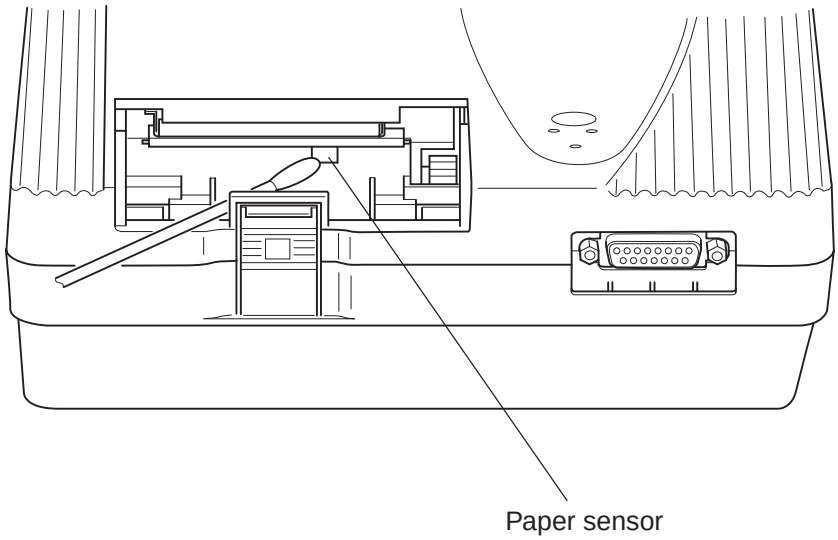
To maintain the performance of the instrument, the parts listed in the table below must be regularly cleaned or lubricated.

Part	Frequency	Performed by
Instrument (external)	After each use	User
Thermal Head	Once a month	User
Platen Roller assy	Once a year	User
Paper Sensor	Once a month	Qualified service personnel
Motor Sensor	Once a year	Qualified service personnel
Motor Gear and Gear Meshed with Motor Gear	Once a year	Qualified service personnel

Cleaning the Paper Mark Sensor and Paper Empty Sensor

1. Remove the magazine. The illustration below shows the location of the paper sensor.

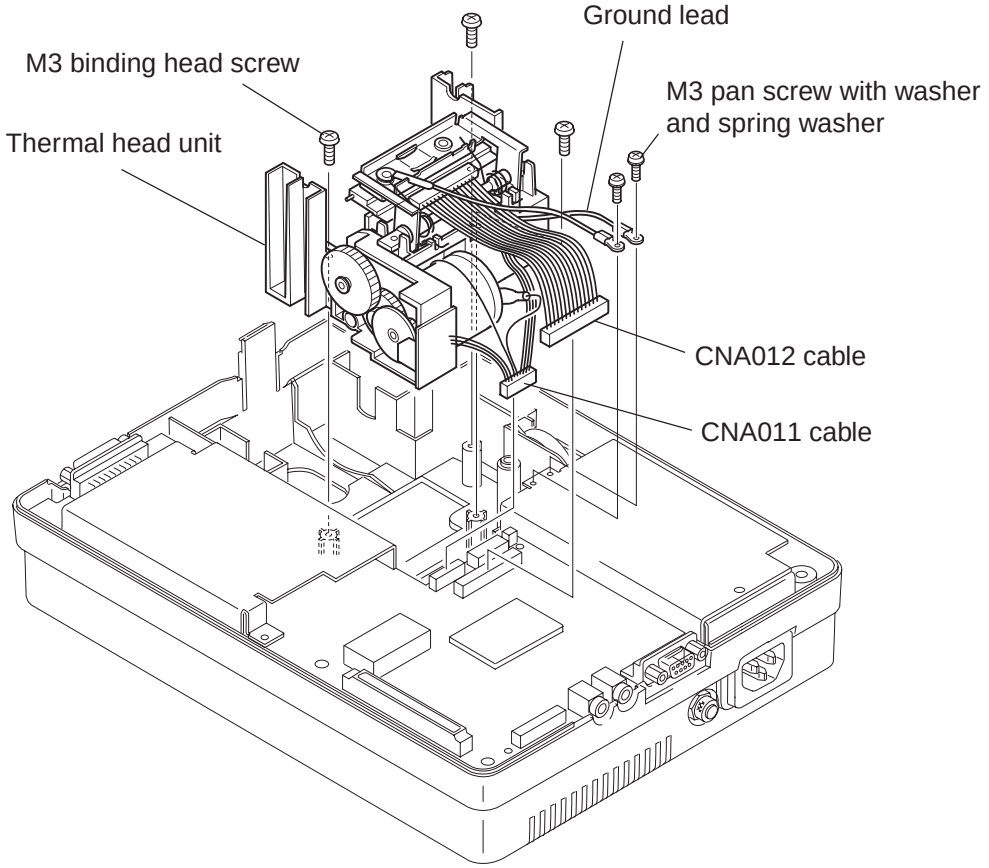
2. Use a piece of cotton moistened with alcohol to clean both sensors.



Cleaning the Motor Rotation Sensor and Lubricating the Motor Gear and Gear Meshed with Motor Gear

1. Remove the upper casing from the lower casing. Refer to “Removing the Upper Casing” in Section 6.

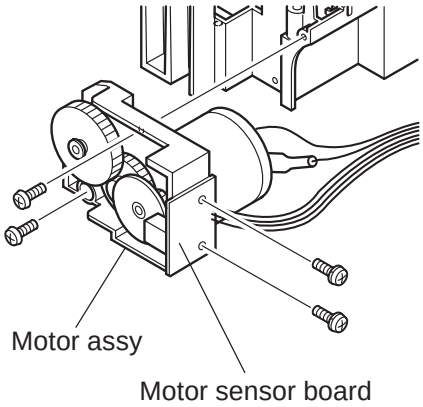
2. Remove the two M3 pan screws with washers and spring washers which fasten the ground leads to the power transformer unit.



3. Disconnect the CNA011 and CNA012 cables from the ECG control board.

4. Remove the three M3 binding head screws which fasten the thermal head unit to the lower casing and remove the thermal head unit.

5. Remove the two M3 binding head screws which fasten the motor assy to the thermal head unit and remove the motor assy.



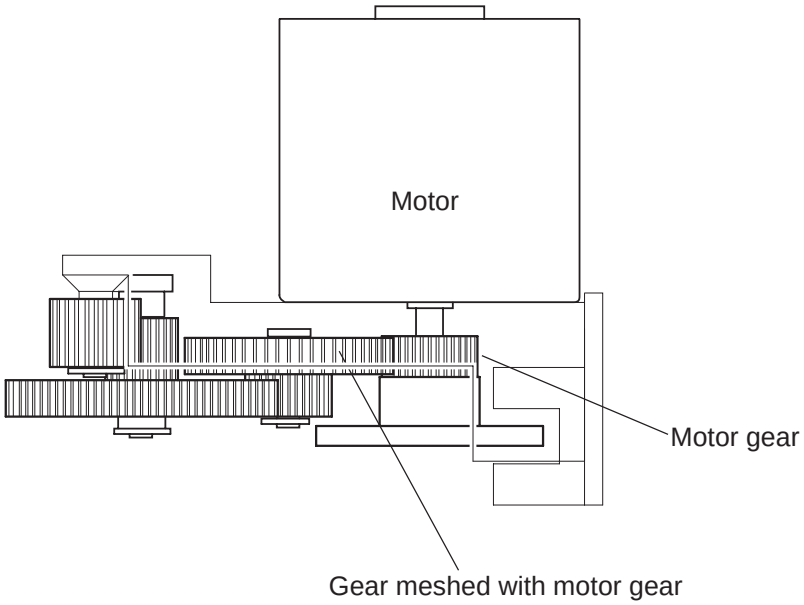
6. Remove the two M3 pan screws with spring washers which fasten the motor sensor board to the motor assy and remove the motor sensor board.

7. Use a piece of cotton moistened with alcohol to clean the motor rotation sensor.

8. Use a brush to clean the holes in the gear.

9. Use grease to lubricate the motor gear and the gear which directly meshes with the motor gear as shown below.

Top view



Maintenance Check Sheet

1/2

Date: _____

Customer: _____

Customer Address: _____

Service Personnel: _____ Service Company: _____

Instrument Name: _____ Instrument Model: _____

Instrument Serial Number: _____ Hardware Revision: _____

Software Revision: _____

Overview	Outside of instrument is clean.	Yes ☐	No ☐
	No loose screws.	Yes ☐	No ☐
	No physical damage, no bent parts and no contact with liquid.	Yes ☐	No ☐
	Operation panel is not torn or broken.	Yes ☐	No ☐
	All keys, buttons and controls are undamaged.	Yes ☐	No ☐
	Power cord, patient cable are not frayed and are correctly connected to the instrument.	Yes ☐	No ☐
	Paper magazine opens and closes correctly.	Yes ☐	No ☐
	Thermal head is clean.	Yes ☐	No ☐
	The paper feeding roller is clean.	Yes ☐	No ☐
	Motor rotation sensor is clean.	Yes ☐	No ☐
	Paper detection sensor is clean.	Yes ☐	No ☐
	Motor gear is lubricated properly.	Yes ☐	No ☐
Accessories	Enough electrolyte cream (CardioCream)	Yes ☐	No ☐
	Enough recording paper.	Yes ☐	No ☐
Installation	Instrument is installed in the proper location.	Yes ☐	No ☐
	Specified 3-prong power cord and ground lead are used.	Yes ☐	No ☐
	Battery pack is in the instrument.	Yes ☐	No ☐
	Recording paper is loaded.	Yes ☐	No ☐
Power on	There is no fire, smoke or smell.	Yes ☐	No ☐
	There is no electrical shock when touching the instrument.	Yes ☐	No ☐
	Instrument is not abnormally hot.	Yes ☐	No ☐
	Instrument does not affect surrounding equipment.	Yes ☐	No ☐
	AC lamp lights when the AC power is supplied.	Yes ☐	No ☐
	Battery charge lamp lights when the AC power is supplied.	Yes ☐	No ☐
Basic operation	The screen display is correct. (brightness, no distortion)	Yes ☐	No ☐
	Key lamp indication is correct.	Yes ☐	No ☐
	All keys operate properly.	Yes ☐	No ☐
	All settings are correct.	Yes ☐	No ☐
	The battery is fully charged.	Yes ☐	No ☐
	Electrode detachment functions properly.	Yes ☐	No ☐
	There is no error message or abnormal operation.	Yes ☐	No ☐

Maintenance Check Sheet

Monitoring	ECG waveform display is correct.	Yes ☐	No ☐
	The continuity of the ECG connection cable is correct.	Yes ☐	No ☐
	Heart rate display is correct.	Yes ☐	No ☐
	QRS sync mark is displayed and heart rate sync sound generates.	Yes ☐	No ☐
	ECG lead and sensitivity can be changed properly.	Yes ☐	No ☐
	Alarms setting and alarm function is correct.	Yes ☐	No ☐
	Sound volume can be changed properly.	Yes ☐	No ☐
Recording	Paper is fed correctly (no skewing or jam).	Yes ☐	No ☐
	Waveforms and letters are clearly recorded.	Yes ☐	No ☐
	Time printed on the recording paper is correct.	Yes ☐	No ☐
System Test	Recorder	Pass ☐	Fail ☐
	Key	Pass ☐	Fail ☐
	Memory	Pass ☐	Fail ☐
	LCD/LED	Pass ☐	Fail ☐
	Input unit	Pass ☐	Fail ☐
	Calibration	Pass ☐	Fail ☐
	Communication	Pass ☐	Fail ☐
	CRO/EXT1	Pass ☐	Fail ☐
Safety	Protective earth resistance	Pass ☐	Fail ☐
	Earth leakage current	Pass ☐	Fail ☐
	Enclosure leakage current	Pass ☐	Fail ☐
	Withstanding voltage	Pass ☐	Fail ☐

Section 3 Troubleshooting and System Error Message

Troubleshooting Flowchart 3.1
Troubleshooting Table 3.4
Troubleshooting General Operation Problem 3.4
Troubleshooting Recording Problem 3.6
System Error Message 3.7

This section describes how to troubleshoot the instrument, using the following:

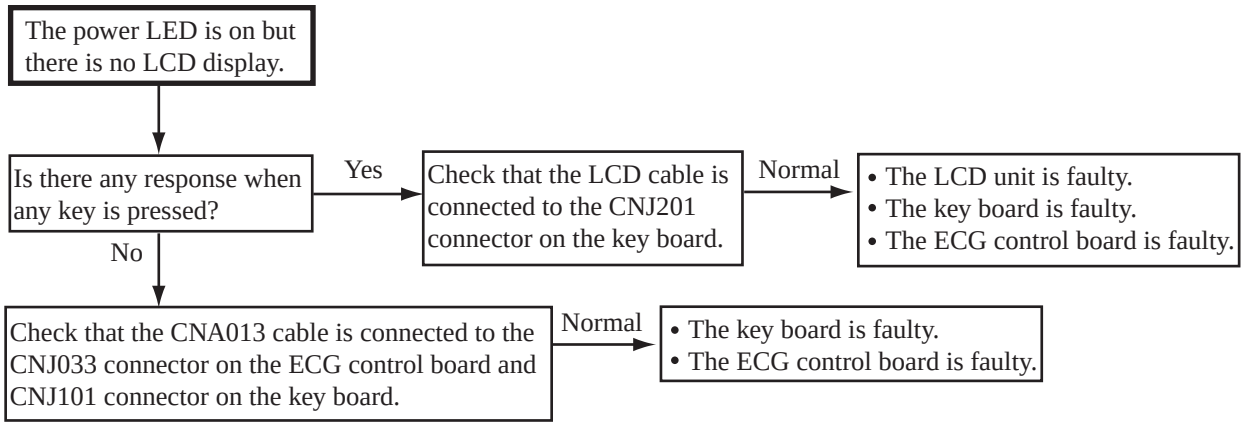
- flowchart
- troubleshooting table
- system error messages at power-up

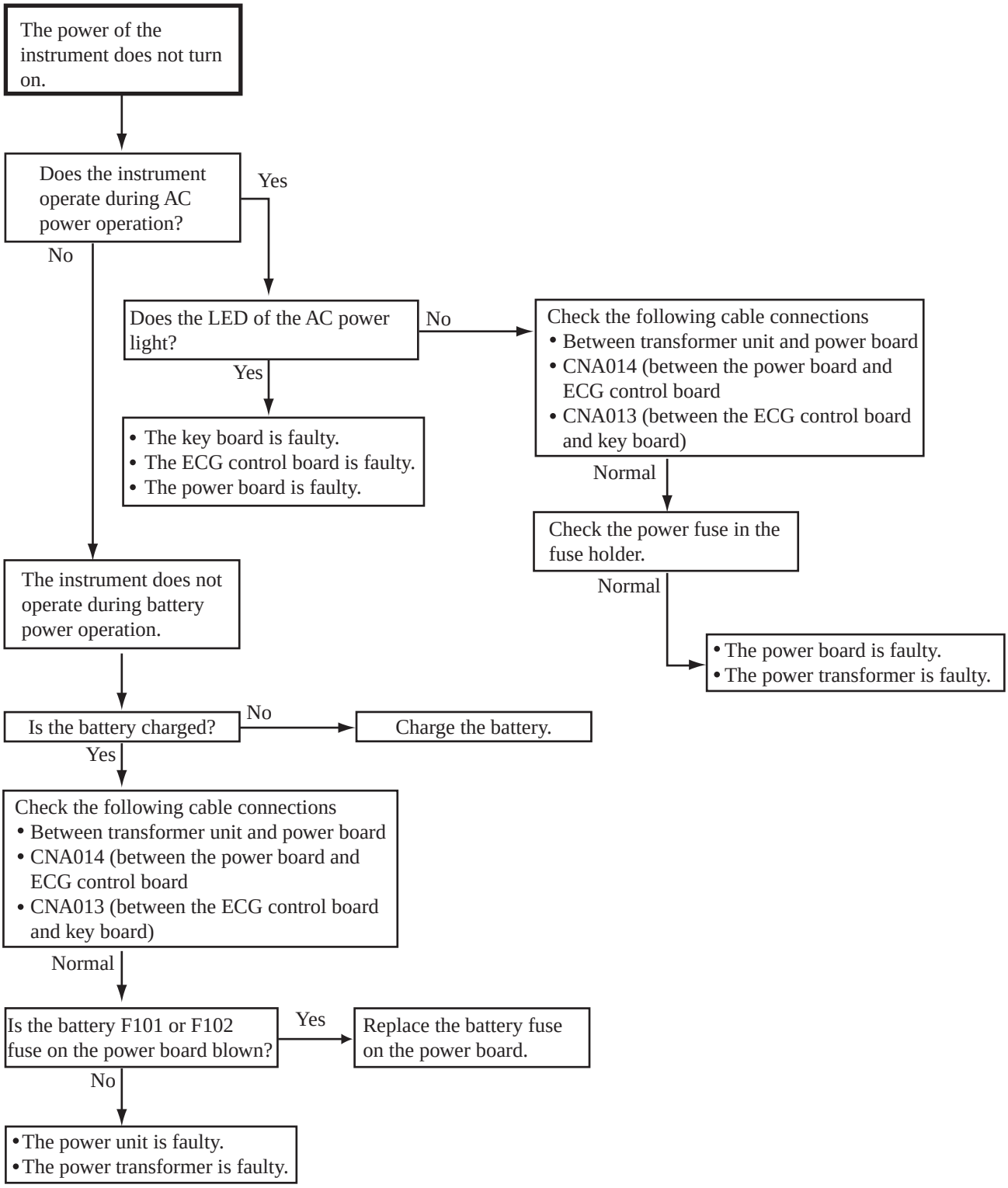
NOTE

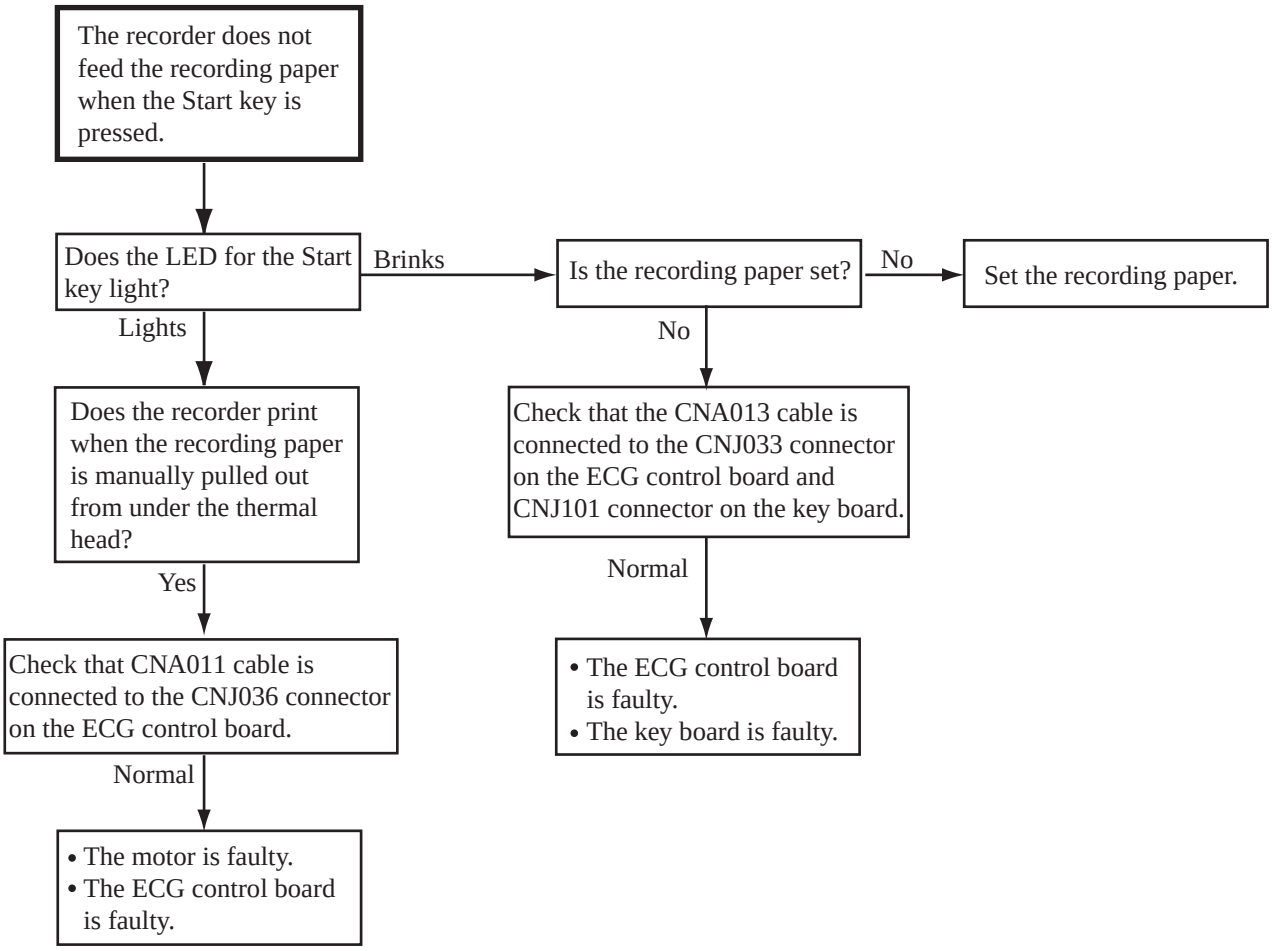
If the power is not turned off by pressing the Power key, press and hold the Power key 5 seconds or more.

Troubleshooting Flowchart

Use the troubleshooting flowchart to find the possible sources of a problem.


The power LED is on but there is no LCD display.
Is there any response when any key is pressed?
Yes
Check that the LCD cable is connected to the CNJ201 connector on the key board.
Normal
• The LCD unit is faulty.
• The key board is faulty.
• The ECG control board is faulty.
No
Check that the CNA013 cable is connected to the CNJ033 connector on the ECG control board and CNJ101 connector on the key board.
Normal
• The key board is faulty.
• The ECG control board is faulty.


The power of the instrument does not turn on.
Does the instrument operate during AC power operation?
Yes
No
Does the LED of the AC power light?
No
Yes
Check the following cable connections
• Between transformer unit and power board
• CNA014 (between the power board and ECG control board
• CNA013 (between the ECG control board and key board)
• The key board is faulty.
• The ECG control board is faulty.
• The power board is faulty.
Normal
Check the power fuse in the fuse holder.
Normal
• The power board is faulty.
• The power transformer is faulty.
The instrument does not operate during battery power operation.
Is the battery charged?
No
Charge the battery.
Yes
Check the following cable connections
• Between transformer unit and power board
• CNA014 (between the power board and ECG control board
• CNA013 (between the ECG control board and key board)
Normal
Is the battery F101 or F102 fuse on the power board blown?
Yes
Replace the battery fuse on the power board.
No
• The power unit is faulty.
• The power transformer is faulty.


The recorder does not feed the recording paper when the Start key is pressed.
Does the LED for the Start key light?
Brinks
Is the recording paper set?
No
Set the recording paper.
Lights
No
Does the recorder print when the recording paper is manually pulled out from under the thermal head?
Check that the CNA013 cable is connected to the CNJ033 connector on the ECG control board and CNJ101 connector on the key board.
Yes
Normal
Check that CNA011 cable is connected to the CNJ036 connector on the ECG control board.
• The ECG control board is faulty.
• The key board is faulty.
Normal
• The motor is faulty.
• The ECG control board is faulty.

Troubleshooting Table

Use the troubleshooting table to locate, identify and solve a problem in the instrument. The problems are divided into general operation and recording. Each category has its own troubleshooting table for fast and easy troubleshooting.

How to use the troubleshooting table

1. Determine which troubleshooting table to use.
2. In the "Problem" column find the trouble item that matches the problem.
3. Do the action recommended in the "Corrective Action" column.
4. If the problem is not solved, do the action for the next possible cause or criteria.
5. If none of the actions solve the problem, contact your nearest Nihon Kohden dealer.

Troubleshooting General Operation Problem

Problem	Possible Cause	Action
The power LED lights but nothing is displayed on the LCD screen.	Faulty cable connection.	Check the following cable connection. CNA013: between the ECG control board and key board LCD cable: CNJ201 connector on the key board. CNA014: between the power board and ECG control board
	Faulty LCD unit.	Replace the LCD unit.
	Faulty key board.	Replace the key board.
	Faulty ECG control board.	Replace ECG the control board.
The instrument does not operate on AC power.	Faulty power fuse.	Replace the power fuse.
	Faulty cable connection	Check the following cable connection. CNA013: between the ECG control board and key board CNA014: between the power board and ECG control board. Power cable: between the power board and power transformer unit
	Faulty power cord	Replace the power cord.
	Faulty power board.	Replace the power board.
	Faulty key board.	Replace the key board.
	Faulty ECG control board.	Replace ECG the control board.
	Faulty power transformer unit,	Replace the power transformer unit.

Problem	Possible Cause	Action
The instrument does not operate on battery power.	The battery is not charged.	Charge the battery.
	Faulty battery fuse.	Replace the battery fuse.
	Faulty battery.	Replace the battery.
		Check the following cable connection. CNA013: between the ECG control board and key board CNA014: between the power board and ECG control board. Battery cable: CNJ102 connector on the power board
	Faulty power board.	Replace the power board.
No key operation	Faulty cable connection	Check the following cable connection. CNA013: between the ECG control board and key board CNA014: between the power board and ECG control board.
	Faulty key board.	Replace the key board.
	Faulty ECG control board.	Replace ECG the control board.
No ECG waveform appears in a specific lead or artifact appears on the waveform.	Faulty electrode attachment.	Check that the electrodes are properly attached to the patient.
	Faulty patient cable connection.	Check that the patient cable is firmly connected to the electrodes and instrument.
	Faulty ECG control board.	Replace the ECG control board.
No ECG waveform appears in all channels or artifact appears on the waveform.	No electrode is attached to the patient or the RF (RL) electrode is not attached to the patient.	Check that the electrodes are properly attached to the patient.
	Faulty ECG control board.	Replace the ECG control board.
Vertical and horizontal stripes appear on the LCD screen at constant interval.	Faulty cable connection.	Check the following cable connection. CNA013: between the ECG control board and key board LCD cable: CNJ201 connector on the key board.
	Faulty ECG control board.	Replace the ECG control board.
	Faulty LCD unit.	Replace the LCD unit.
No sound	Faulty cable connection.	Check that the speaker cable is firmly connected to the CNJ032 connector on the ECG control board.
	Faulty speaker.	Replace the speaker.
The date and time is reset to January 1, 1980 and the “Error 09” error message appears.	The lithium battery is completely discharged.	Replace the ECG control board. The lithium battery is in the real time clock IC on the ECG control board.

Troubleshooting Recording Problem

Problem	Possible Cause	Action
The recorder does not feed the recording paper when the Start key is pressed.	Dirty paper sensor.	Clean the paper sensor.
	Faulty cable connection.	Check the following cable connection. CNA013: between the ECG control board and key board CNA011: between the ECG control board and feeding motor, motor sensor and paper sensor
	Faulty key board.	Replace the key board.
	Faulty ECG control board.	Replace the ECG control board.
	Faulty feeding motor.	Replace the feeding motor.
No printing.	The thermal head is incorrectly positioned.	Readjust the position of the thermal head.
	Faulty cable connection.	Check the following cable connection. CNA013: between the ECG control board and key board CNA011: between the ECG control board and feeding motor, motor sensor and paper sensor
	Faulty thermal head.	Replace the thermal head.
	Faulty power board.	Replace the power board.
	Faulty ECG control board.	Replace the ECG control board.
Sometimes the recorder does not print.	The thermal head protection circuit which protects the thermal head from large artifact, such as AC interference is rejecting noisy waveforms.	Check the electrode attachment. If necessary, adjust the electrode position so that clear ECG waveforms are displayed.
The paper skews.	Dirty thermal head.	Clean the thermal head.
	The recording paper is not properly set in the instrument.	Make sure that the recording paper is aligned with the lower recording paper guide.
	The thermal head is incorrectly positioned.	Readjust the position of the thermal head.
	Faulty feeding roller.	Replace the paper magazine.

System Error Message

During power-up and operation the instrument continuously checks itself for system failure. If a failure is detected, system information and error history are printed on the recording paper and all operations are stopped. System information and error history are also displayed or printed due to transient noise. After printing the system information and error history, the power of the instrument is automatically turned off.

NOTE

If the same system information appears again after restarting the instrument, do not use the instrument until service personnel has corrected the cause of the problem. Sending a copy of the system information to your nearest Nihon Kohden distributor helps us to troubleshoot your problem quickly.

System Information

Indicates an error number to identify the problem. To solve the problem, do the corrective action described below.

Error No.	Meaning	Corrective Action
00	Input unit error: An interrupt signal of 2 ms is generated.	Replace the ECG control board.
01	Input unit error: There is no response to the host.	Replace the ECG control board.
02	Input unit error: Communication protocol error.	Replace the ECG control board.
03	4 bit CPU error: Initialization error.	Replace the ECG control board.
04	4 bit CPU error: “No response” error.	Replace the ECG control board.
05	A key on the key board is short-circuited.	Replace the key board.
06	RTC error: No interrupt signal of 125 ms.	Replace the ECG control board.
07	RTC error: Incorrect data in SRAM.	Replace the ECG control board.
09	The lithium battery to back up the date and time and all system settings is completely discharged. The system settings other than the items described in the following note are returned to the factory initial settings.	Replace the ECG control board. The lithium battery is in the real time clock IC on the ECG control board. The date and time is reset to January 1, 1980.
10	Bus error.	Replace the ECG control board.
11	Address error.	Replace the ECG control board.

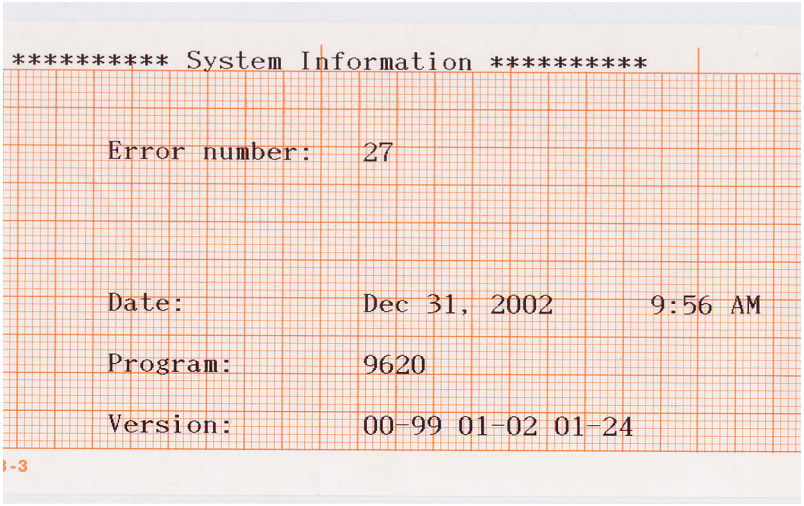
Error No.	Meaning	Corrective Action
12	Illegal command.	Replace the ECG control board.
13	Zero division error.	Replace the ECG control board.
14	Power off time out.	Replace the ECG control board.
15	EEPROM error: This occurs due to the EEPROM check error, installed language error or communication error between the host and EEPROM.	Replace the ECG control board.
16	Local language flash memory error.	Replace the ECG control board.
17	ECG model error.	Replace the ECG control board.
18	Local language is not installed.	Install the local language.
19	Local language is not installed.	Install the local language.
	Error in memory area for local language.	Re-install the local language.
20	Local language text file version does not match the ECG software version.	Install the local language text file which is the same version as the ECG software.
21	ECG interpretation error (Time over).	Check the input waveforms. If any noise is superimposed on the waveforms, find and eliminate the cause. If no noise is superimposed on the waveform, replace the ECG control board.
22	The entered information does not match the data in the flash memory.	Replace the ECG control board.
27	Program version error. The program is updated.	Turn the power off, then on and check that the ECG waveforms are displayed correctly.

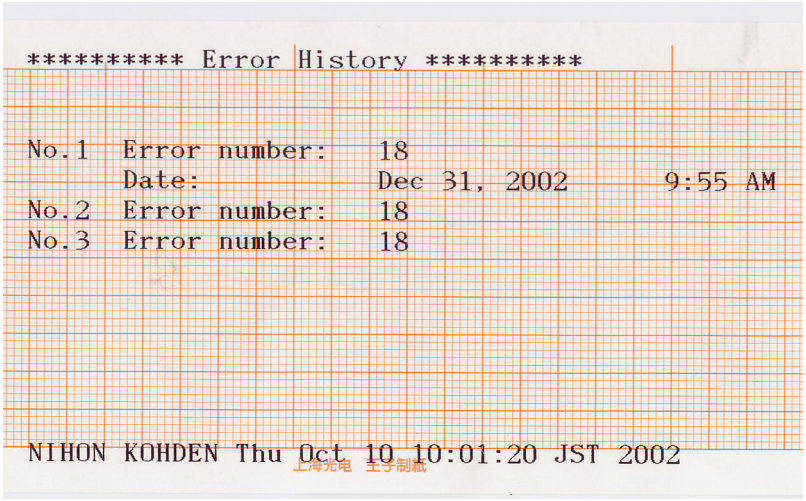
NOTE

- **"Error 05" also appears when any key on the operation panel is pressed and held down.**
- **When "Error 08" appears, the following settings are not reset to the factory initial settings even if the instrument is initialized.**
  - **display language**
  - **hospital name**
  - **recording resolution setting**
  - **local language font**
  - **hum filter**
  - **direct/modem connection**
  - **elapsed time**
  - **saved ECG data**

Error History

Indicates the latest three errors and the date of the latest error, as in the example below.




********** Error History **********
No.1 Error number: 18
Date: Dec 31, 2002 9:55 AM
No.2 Error number: 18
No.3 Error number: 18
NIHON KOHDEN Thu Oct 10 10:01:20 JST 2002

Section 4 System Test, Adjustment, And Setting

System Test 4.1
- Overall 4.1
- Calling up the System Test Level 1 ..... 4.2
- Calling up the System Test Level 2 ..... 4.3
- Entering the System Test Number 4.4
- Executing the System Test 4.5
- Quitting the System Test 4.6
- Exiting the System Test Mode 4.6

Demonstration 4.7
Recorder 4.8
Thermal Head 4.10
Key 4.11
Memory 4.12
- Single Memory Test Mode 4.13
- Continuous Memory Test Mode 4.13

LCD/LED 4.14
Input Unit 4.16
Calibration 4.17
Communication 4.18
CRO/EXT1 ..... 4.20
System Setup Initialization 4.22
ECG Findings List Recording 4.23
Recording Resolution Setting 4.24
Date and Time Setting 4.25
- Setting the Date and Time 4.25

This section describes:

- how to check the operation of the instrument in the System Test mode.
- how to output the ECG findings list in the System Test mode.
- how to initialize the system in the System Test mode.
- how to adjust the thermal head recording resolution and recording paper cutting position in the System Test mode.
- how to set date and time in the System Setup mode.

System Test

Overall

The instrument has two System Test modes: Test level 1 for operator and Test level 2 for qualified service personnel. The test items marked with "*" perform the same test in Test levels 1 and 2. Each Test level consists of the following system test items:

Test level 1

- Demonstration
- Recorder
- Key*
- Memory*
- LCD/LED*
- Input unit*
- Calibration*
- Communication*
- CRO/EXT1*
- System Setup Initialization*
- ECG Findings List Recording

Test level 2

- Recorder
- Thermal head
- Key*
- Memory (single)*
- Memory (continuous)
- LCD/LED*(
- Input unit*
- Calibration*
- Communication*
- CRO/EXT1*
- System Setup Initialization*
- Recording resolution setting

NOTE

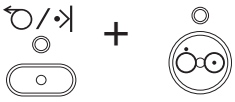
In the description of some test items in this section, whenever it is appropriate, a description of the source of problem and its corrective action will be described in table form for fast and easy troubleshooting. If none of the actions solve the problem, contact your Nihon Kohden distributor or representative.

Calling up the System Test Level 1

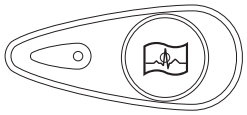
1. If the power is on, turn it off.

NOTE

Release the Feed/Mark key immediately after the instrument starts printing. If you continue to hold the Feed/Mark key for more than 15 seconds, the instrument recognizes that the Feed/Mark key is short-circuited and prints the system information "Error 05" at the end of printing.



2. Press the Power key while pressing the Feed/Mark key. Hold the Feed/Mark key until the instrument begins to print the system test procedure, relationship between the input number and its corresponding key name on the operation panel and system test number list as shown below. The Test level 1 is called up and the instrument is in standby mode for entering the system test number.



To cancel printing the following information, press the Start/Stop key.

.

Printout

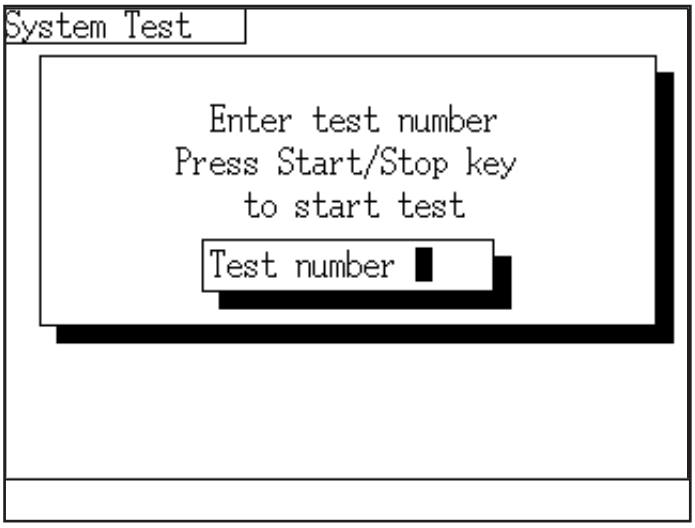
System Test
1:
To check system, press system test number, then press START/STOP key.
2:
To quit the test, press AUTO/MANUAL key.

Key Explanation
0: COPY/CAL
1: F1
2: F2
3: F3
4: MODE
5: RHYTHM
6: AGE
7: SEX
8: FEED/MARK
9: FILTER

Test level 1
Demonstration [00]
Recorder [01]
Key [02]
Memory [03]
LCD/LED [04]
Input unit [05]
Calibration [06]
Communication [07]
CRO/EXT1 [08]
System Setup Initialization [10]
ECG Findings List Recording [11]

9620 00-99 01-02 01-24

System Test Screen



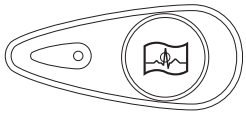
Calling up the System Test Level 2

1. If the power is on, turn it off.

NOTE

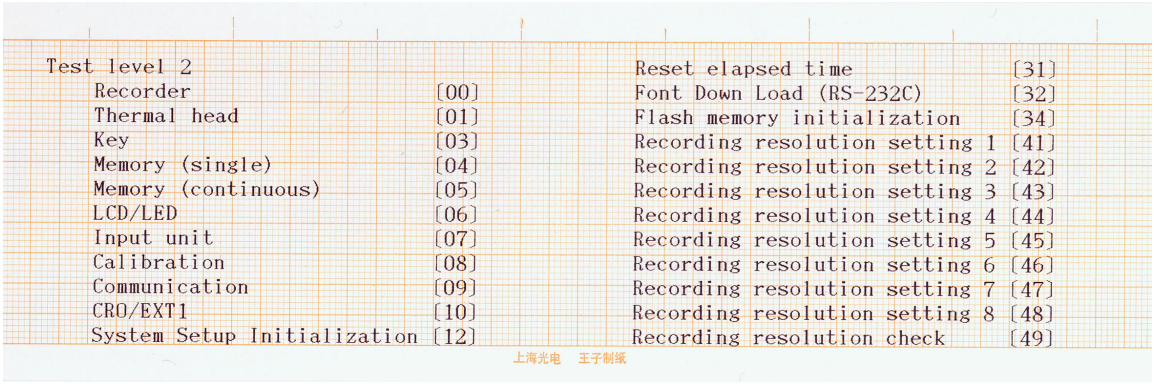
Release the Feed/Mark key immediately after the instrument starts printing. If you continue to hold the Feed/Mark key for more than 15 seconds, the instrument recognizes that the Feed/Mark key is short-circuited and prints the system information "Error 05" at the end of printing.

2. Press the Power key while pressing the Feed/Mark and Auto/Manual keys together. Hold the Feed/Mark and Auto/Manual keys until the instrument begins to print the system test procedure, relationship between the input number and its corresponding key name on the operation panel and system test number list as shown below. The Test level 2 is called up and the instrument is in standby mode for entering the system test number.



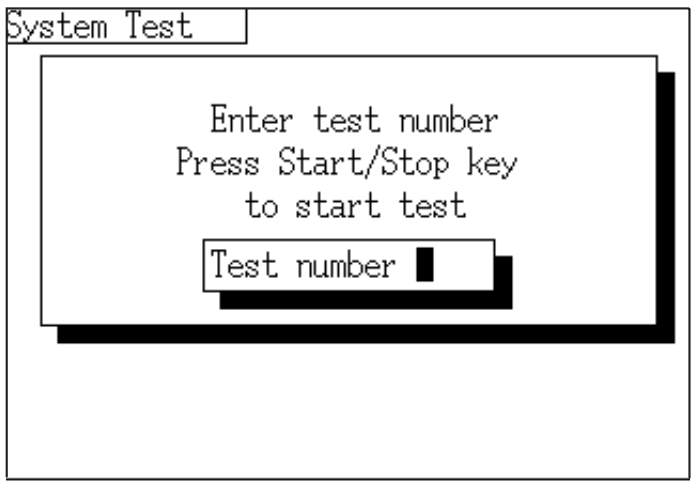
To cancel printing the following information, press the Start/Stop key.

Printout



```
Test level 2
    Recorder                          [00]
    Thermal head                      [01]
    Key                               [03]
    Memory (single)                   [04]
    Memory (continuous)               [05]
    LCD/LED                           [06]
    Input unit                        [07]
    Calibration                       [08]
    Communication                     [09]
    CRO/EXT1                          [10]
    System Setup Initialization       [12]
    Reset elapsed time                [31]
    Font Down Load (RS-232C)          [32]
    Flash memory initialization       [34]
    Recording resolution setting 1    [41]
    Recording resolution setting 2    [42]
    Recording resolution setting 3    [43]
    Recording resolution setting 4    [44]
    Recording resolution setting 5    [45]
    Recording resolution setting 6    [46]
    Recording resolution setting 7    [47]
    Recording resolution setting 8    [48]
    Recording resolution check        [49]
```

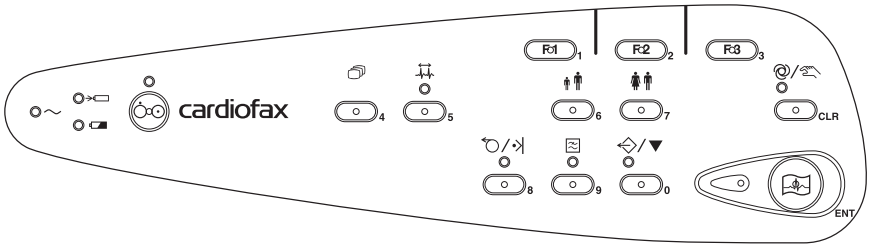
System Test Screen



Entering the System Test Number

Use the following keys on the operation panel to enter a 2-digit number for executing the desired system test. The specified system test numbers are indicated in the [*xx*] bracket at the right of each system test item on the printout output when the Test level 1 or 2 is called up. Refer to the "Calling up the Test Level X" section.

To delete the entered number, press the Auto/Manual key. To delete a 2-digit number, press the Auto/Manual key twice. At this time, the ones digit number is deleted before the tens digit number is deleted.

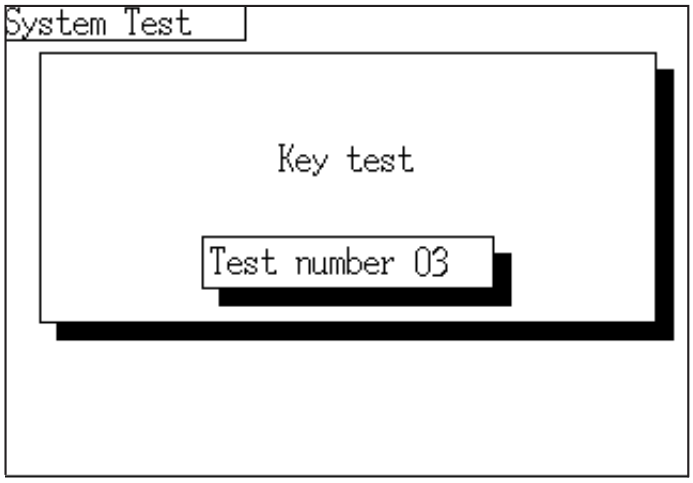


Numeric	Key		Numeric	Key	
0	Copy/CAL key		5	Rhythm key	
1	F1 function key		6	Age key	
2	F2 function key		7	Sex key	
3	F3 function key		8	Feed/Mark key	
4	Mode key		9	Filter key	
Clear	Auto/Manual key		Enter	Start/Stop key	

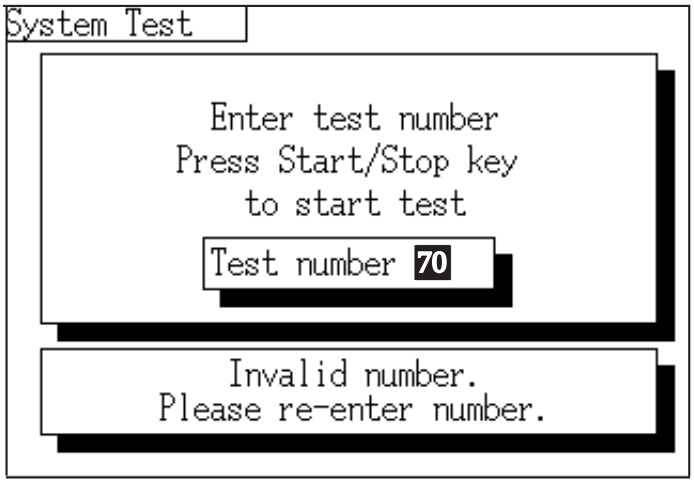
Executing the System Test

Press the Start/Stop key. For some tests, the System Test screen is displayed during the test as shown below,

System Test Screen



If you entered an unspecified number, 8 repeating “pips” alarm sound and the “Invalid number. Please re-enter number” error message is displayed as shown below.



To re-enter the system test number, do either of the following:

- Delete the previously entered number by pressing the Auto/Manual key.
- Enter the system test number by overwriting the previously entered number.

Quitting the System Test

The procedures to quit each system test vary from test to test. Some tests automatically end after an alarm sound is generated or a printout is output. Refer to the following explanations for each test. After quitting each test, the instrument returns to the standby mode for entering the system test number.

After a system test is completed, you can execute other system test without exiting the System Test mode.

Exiting the System Test Mode

After all desired system tests are finished, press the Power key.

Demonstration

This is used to learn or demonstrate instrument operation.

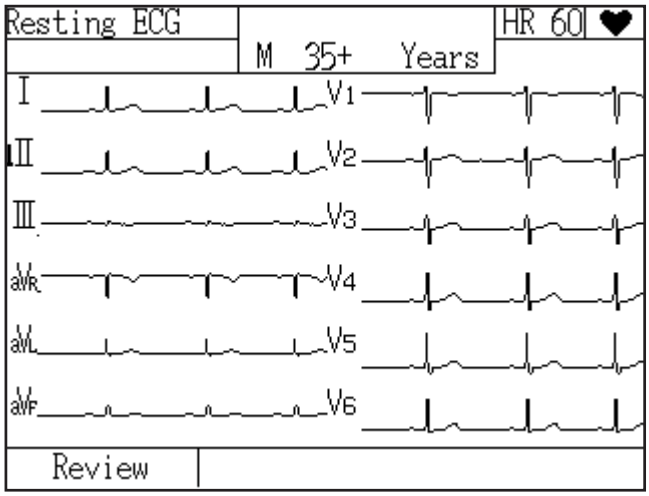
While executing this test item, the instrument generates dummy 12 lead ECG resting waveforms until the power of the instrument is turned off. The ECG waveforms can be recorded and also displayed as shown below.

Procedure

Enter the system test number [00] (Test level 1) and press the Start/Stop key.

To quit the test, turn the power of the instrument off by pressing the Power key.

Dummy 12 lead ECG resting waveforms on LCD



Recorder

This is used to check the condition of the recorder by printing test patterns. The recording test patterns consist of the following and are printed in the following order:

1. Diagonal lines
2. Characters H and X (Test level 1 only)
3. Paper speed scales (25 and 50 mm/s)

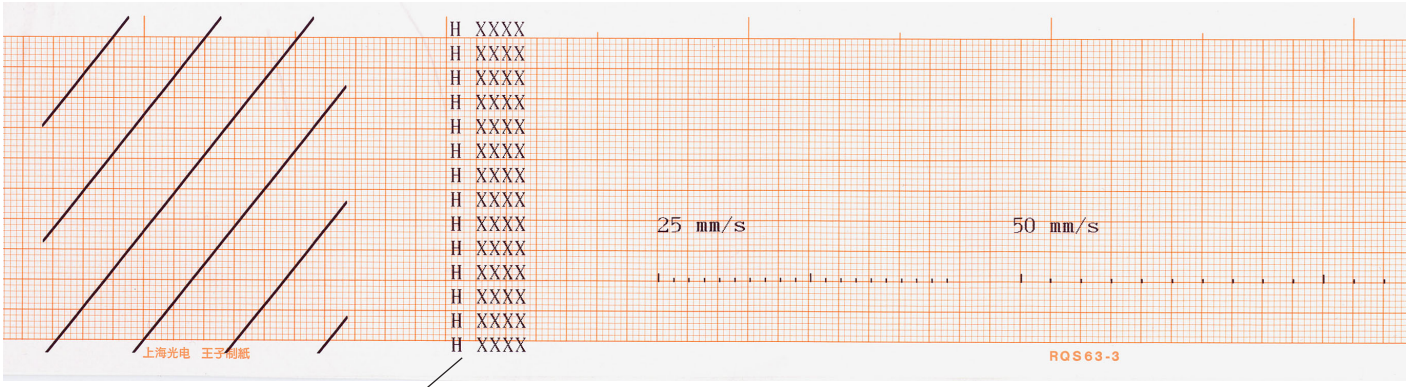
The recorder test of Test level 1 contains the same recorder test and thermal head test as Test level 2. With regard to the check procedure for characters H and X, refer to the “Thermal Head” section.

Procedure

Enter the system test number [01] (Test level 1) or [00] (Test level 2) and press the Start/Stop key. The following test patterns are printed.

This test automatically ends after the following has been printed. The instrument returns to the standby mode for entering the system test number.

Printout of Test level 1



Not printed in Test level 2. Refer to the “Thermal Head” section for this check.

Check Procedure for Diagonal Lines

Check that all the diagonal lines are evenly and completely printed.

Possible Source of Problem	Corrective Action
A dirty thermal head can cause some parts to be unevenly or incompletely printed.	1. Clean the thermal head with the thermal head cleaner pen. 2. If this does not fix the problem, replace the thermal head.
A faulty thermal head can cause some parts at a certain position to be unevenly or incompletely printed.	1. Clean the thermal head with the thermal head cleaner pen. 2. If this does not fix the problem, replace the thermal head.

Check Procedure for Paper Speed Scales

Check that the accuracy of each paper speed during actual recording is within 2%. The scales for 4 seconds at 10 mm/s and 12.5 mm/s paper speeds and the scales for 2 seconds at 25 mm/s and 50 mm/s paper speeds are consecutively printed. For example, the length for 4 seconds on the time scale printed at 10 mm/s paper speed must be within 39.2 mm to 40.8 mm.

Possible Source of Problem	Corrective Action
Badly positioned thermal head.	1. Adjust the thermal head position. 2. If this does not fix the problem, replace the thermal head.
Damaged, deformed or badly positioned motor gear.	1. Check the motor gear and its position. 2. If this does not fix the problem, replace the motor gear.
Dirty motor rotation sensor.	Clean the motor rotation sensor as described in the “Maintenance” section.
Loose or damaged axle.	Tighten and check the axle as described in the “Disassembly and Assembly” section.
Faulty motor.	Replace the motor.
Faulty ECG control board.	Replace the ECG control board.

Thermal Head

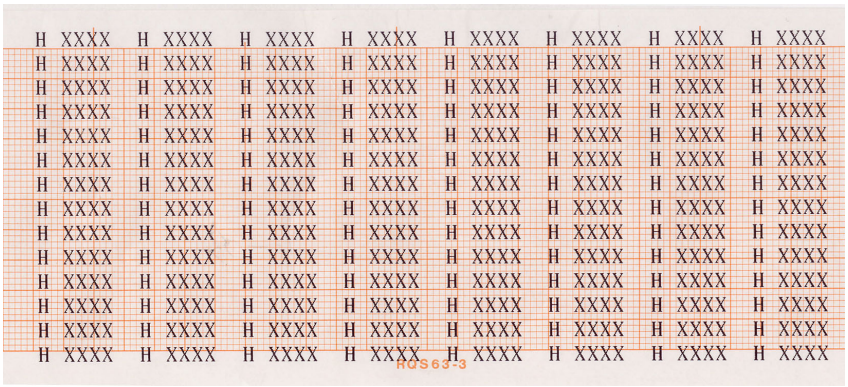
This is used to check the condition of the thermal head by printing out the characters “H” and “X” continually.

Procedure

Enter the system test number [01] (Test level 2) and press the Start/Stop key. The characters “H” and “X” are printed as follows.

To quit the test, press the Auto/Manual key and the instrument returns to the standby mode for entering the system test number.

Printout of Thermal Head Test Result



Check Procedure for Characters H and X

Check that all the parts of the characters “H” and “X” are clearly, evenly and completely printed and that the characters are not printed zigzag or diagonally.

Possible Source of Problem	Corrective Action
The thermal head recording resolution is not set correctly.	Adjust the thermal head recording resolution as described in this section.
Faulty cable connection.	Check the following cable connection. CNA014: between the ECG control board and power board CNA012: CNJ033 connector on the ECG control board.
Faulty power board.	Replace the power board.
The thermal head unit position is not correct.	Check and adjust the thermal head unit position.

Key

This is used to check the condition of the keys on the operation panel.

Procedure

1. Enter the system test number [02] (Test level 1) or [03] (Test level 2) and press the Start/Stop key.

2. Press the key on the operation panel. The name of the pressed key is printed if the key is functioning correctly.

To quit the test, press the Auto/Manual key. The instrument returns to the standby mode for entering the system test number.

NOTE

The Power and Auto/Manual keys cannot be checked by this test. To check if these two keys are functioning correctly, do the following:

- **Power key**
  Check that the power of the instrument is on or off when the Power key is turned on or off.
- **Auto/Manual key**
  Check that the Key test is stopped by pressing the Auto/Manual key.

Check Procedure for Operation Panel Key

Check that the name of the pressed key is printed.

Possible Source of Problem	Corrective Action
Faulty key board.	Replace the key board.

Memory

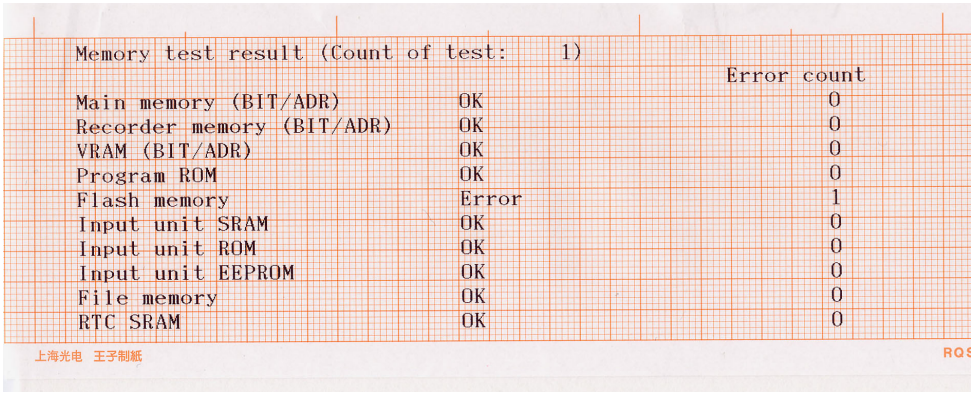
This is used to check the condition of the memory by comparing the data of the test patterns written to and read from each memory area.

The instrument provides two memory test modes: single and continuous. When single memory test mode is selected, entire memory is tested once. When continuous memory test mode is selected, the memory is continuously tested until the Auto/Manual key is pressed. The number of “Count of test” increases by one each time the entire memory test is tested. One complete memory test takes about 30 seconds.

- Single: [03] Test level 1, [04] Test level 1
- Continuous: [05] Test level 2

If no fault is detected, an “OK” message appears for each memory. If a fault is detected, an “Error” message appears and the number of “Error count” for each memory increases by one.

Printout of Memory Test Result



Memory test result (Count of test: 1)

		Error count
Main memory (BIT/ADR)	OK	0
Recorder memory (BIT/ADR)	OK	0
VRAM (BIT/ADR)	OK	0
Program ROM	OK	0
Flash memory	Error	1
Input unit SRAM	OK	0
Input unit ROM	OK	0
Input unit EEPROM	OK	0
File memory	OK	0
RTC SRAM	OK	0

Single Memory Test Mode

This mode tests the entire memory once. You can use this mode to fully check all memory if a memory problem frequently occurs.

Procedure

Enter the system test number [03] (Test level 1) or [04] (Test level 2) and press the Start/Stop key.

After the test, the test result is automatically printed. When the test result is completely printed, a "bing bong" alarm sound is generated and instrument returns to the standby mode for entering the system test number.

To cancel the test or cancel printing the test result, press the Auto/Manual key.

Check Procedure for Single Memory Test Mode

Check that no "Error" messages appear.

Possible Source of Problem	Corrective Action
Faulty memory on the ECG control board.	Replace the ECG control board. Each memory mounted on the ECG control board cannot be replaced at memory component level.

Continuous Memory Test Mode

This mode continues testing the entire memory until the Auto/Manual key is pressed. You can use this mode to check an intermittent memory problem.

Procedure

Enter the system test number [05] (Test level 2) and press the Start/Stop key.

To print the test result without quitting the test, press the Start/Stop key. All results of the tests performed until the Start/Stop key are pressed is printed on one page.

To cancel the test, press the Auto/Manual key. All results of the tests performed until the Start/Stop key is pressed are printed on one page. When the test result is completely printed, 8 repeating "pips" alarm sound is generated and the instrument returns to the standby mode for entering the system test number.

Check Procedure for Continuous Memory Test Mode

Check that no "Error" messages appear.

Possible Source of Problem	Corrective Action
Faulty memory on the ECG control board.	Replace the ECG control board. Each memory mounted on the ECG control board cannot be replaced at memory component level.

LCD/LED

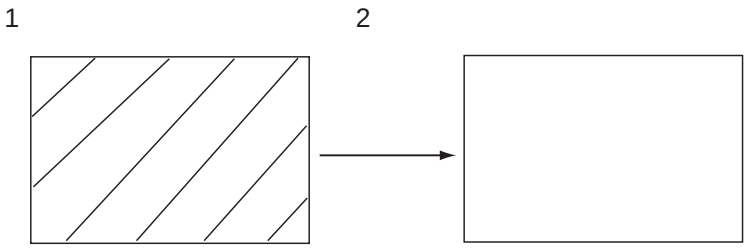
This is used to check all LEDs on the operation panel, LED/LCD control circuit and all dots on the LCD First, the LCD test starts and after the LCD test is complete, the LED test starts.

LCD Test

The LCD displays the following four types of test patterns every two seconds in the following order:

1. Diagonal lines are displayed.
2. Entire LCD lights up.
3. Returns to the System Test screen.

The LCD image for each pattern changes as follow:



LED Test

The LEDs on the operation panel light up one by one and remain lit until all LEDs light up. After all LEDs light up, they go out one at a time.

NOTE

With regard to the LEDs of Battery charge lamp, AC power lamp and POWER lamp, check if they are in the following condition during the LED/LCD test:

- **Battery charge lamp: Not lit (This lamp indicates the remaining battery power before and after the LED test during battery operation.)**
- **AC power lamp: Lit**
- **POWER lamp: Lit when AC power is used**

Procedure

Enter the system test number [04] (Test level 1) or [06] (Test level 2) and press the Start/Stop key.

After the test, the instrument returns to the standby mode for entering the system test number.

To cancel the test, press the Auto/Manual key.

Check Procedure for LCD Test

Check that all the dots on the screen light up and go out according to the test pattern.

Possible Source of Problem	Corrective Action
Faulty cable connection.	Check the following cable connection. CNA013: between the ECG control board and key board. LCD cable: CNJ201 connector on the key board.
Faulty LCD unit.	Replace the LCD unit.
Faulty ECG control board.	Replace the ECG control board.
Faulty key board.	Replace the key board.

Check Procedure for LED Test

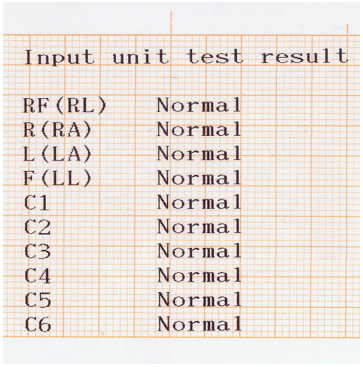
Check that all the LEDs on the operation panel light up.

Possible Source of Problem	Corrective Action
Faulty cable connection.	Check the following cable connection. CNA013: between the ECG control board and key board.
Faulty key board.	Replace the key board.
Faulty ECG control board.	Replace the ECG control board.

Input Unit

This is used to check if the input analog signal processing circuit detects the lead off condition correctly, using the provided input check jig. If each lead is connected when the input analog signal processing circuit works correctly, the "Normal" message is printed at the right of each electrode lead name in the test result. If a lead is not connected, the "Error" message is printed.

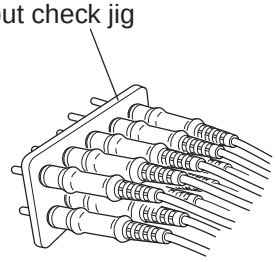
The following is an example printout of the input unit test result when the R(RA) lead is disconnected.



Procedure

1. Connect the electrode lead to the instrument.
2. Attach all tips of each electrode lead to the input check jig.

Input check jig



3. Enter the system test number [05] (Test level 1) or [07] (Test level 2).
4. Disconnect one of the leads from the check jig and press the Start/Stop key. The disconnected lead name is printed out.
5. Repeat steps 3 and 4 for all leads by one.

   To quit the test, press the Auto/Manual key. The instrument returns to the stanby mode for entering the system test number.

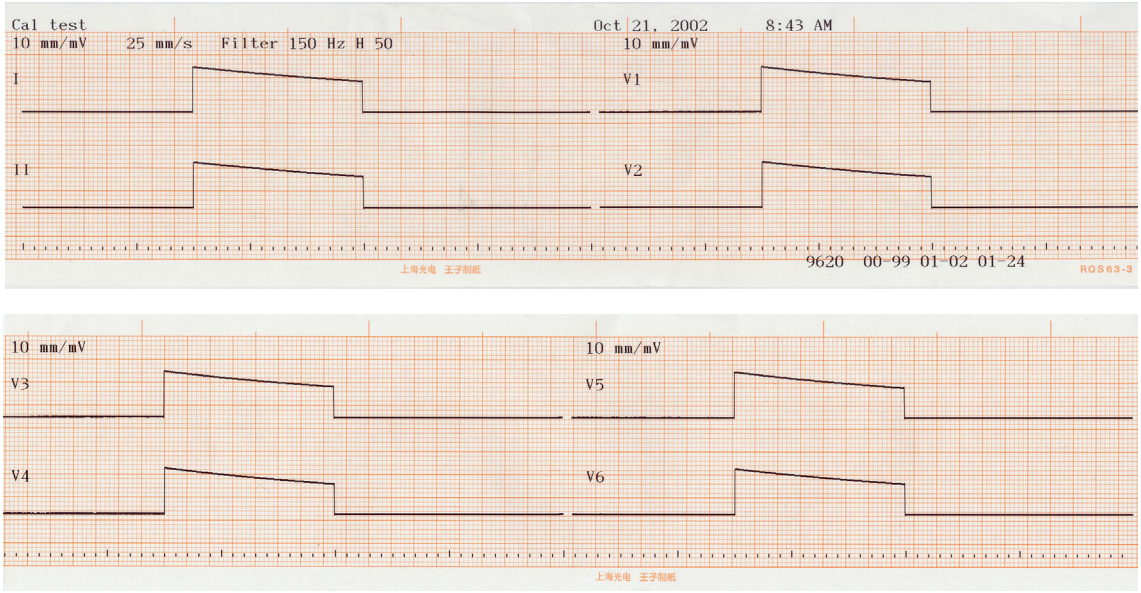
Check Procedure for Input Unit Test

Check that the lead off condition is detected correctly.

Possible Source of Problem	Corrective Action
Faulty cable connection.	Check the following cable connection. CNA013: between the ECG control board and key board.
Faulty key board.	Replace the key board.
Faulty ECG control board.	Replace the ECG control board.

Calibration

This is used to check the sensitivity and time constant of the input analog signal processing circuit. After starting the test, the CAL waveforms for leads I, II and V1 to V6 are printed as shown below. If all the rectangular printed CAL waveforms have the amplitude of 1 mV and time constant of more than 3.2 seconds, the sensitivity and time constant of the input analog signal processing circuit are normal.



Procedure

Enter the system test number [06] (Test level 1) or [08] (Test level 2) and press the Start/Stop key.

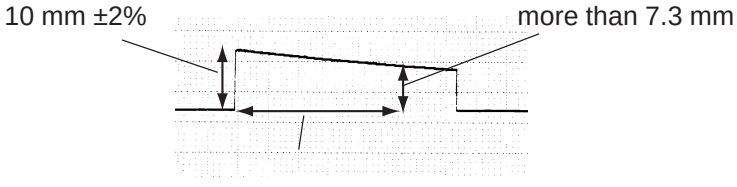
After all CAL waveforms for eight leads are printed, the test automatically ends and the instrument returns to the standby mode for entering the system test number.

To cancel the test, press the Start/Stop key or Auto/Manual key. The instrument returns to the standby mode for entering the system test number.

Check Procedure for Calibration Waveforms

Check that all the rectangular printed CAL waveforms match the following conditions in the illustration below:

- Amplitude when CAL waveform is risen: 10 mm ±2%
- Amplitude of point which is 25 mm : more than 7.3 mm
  from the rising point of the CAL waveform



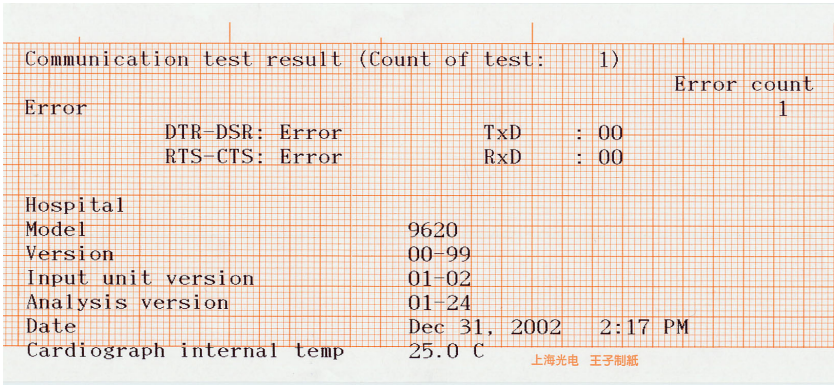
Possible Source of Problem	Corrective Action
Faulty ECG control board.	Replace the ECG control board.

Communication

This is used to check the external communication input/output line of the instrument, using the check jig. The instrument has one standard communication connector (SIO). This test is performed by comparing the original test patterns sent from the output line with the test patterns received at the input line. If any received test pattern is different from its original, a “Error” message is printed. A “Normal” message is printed if the communication line is normal. With regard to TxD-RxD line, if the same data is printed, the line is normal.

Every time the test of one set is repeated, the number of “Count of test” increases by one. Every time the error is detected during continuous test, the “Error count” increases by one. The test of one set takes about 5 seconds.

The following is an example printout of the communication test result.



Preparation

A locally made check jig is required for the test. To make the check jig, short-circuit the pins as shown below.

Connector Pin Assignment

1. FG
2. TXD
3. RXD
4. RTS
5. CTS
6. DSR
7. GND
8. HS
9. DTR

Mating Connector

Connector: HDEB-9PF (05)
Case: HDE-CTH

Procedure

1. Connect the check jig to the SIO socket of the instrument.

2. Enter the system test number [07] (Test level 1) or [09] (Test level 2) and press the Start/Stop key.

   The instrument prints the test result of each test if the instrument detects an "Error".

   To print the test result without quitting the test, press the Start/Stop key. The results of all tests performed until the Start/Stop key are pressed are printed. You can see the test number and the number of errors on "Count of test" and "Error count" on the printout, respectively.

   To quit the test, press the Auto/Manual key. The instrument prints the results of all tests performed until the Auto/Manual key is pressed. When the test result is completely printed, 8 repeating "pips" sound is generated and the instrument returns to the standby mode for entering the system test number.

Check Procedure for Serial Communication

Check that no error messages appear.

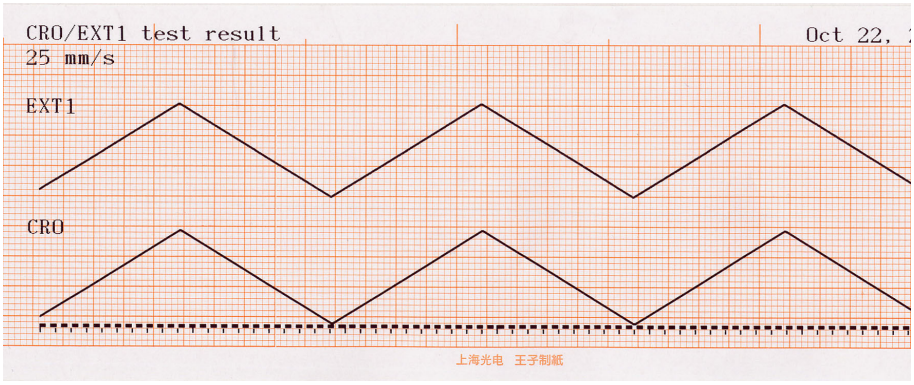
Possible Source of Problem	Corrective Action
Faulty ECG control board.	Replace the ECG control board.

CRO/EXT1

This is used to check the external output/input terminal, using the check jig. The instrument has the input signal terminal (EXT-IN connector) and output signal terminal (CRO-OUT connector) at the rear of the instrument.

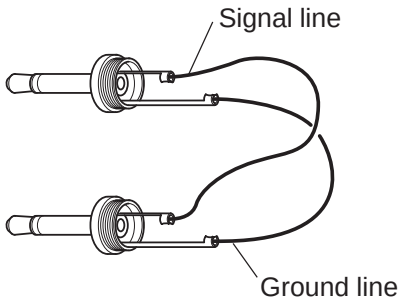
In this test, the instrument prints the known triangular waveform signals generated inside the instrument at the lower trace on the recording paper the moment the instrument outputs the signals from the CRO-OUT terminal to the EXT-IN connector. At the same time, the instrument prints the triangular waveform signals input to the EXT-IN connector at the upper trace on the recording paper. There is no delay time between the printed waveforms on the upper and lower traces.

The following is an example printout of the CRO/EXT1 test result.



Preparation

A locally made check jig is required for the test. To make the check jig, use the two 3.5ϕ monaural jacks and leads and solder the signal line and ground line of the two jacks with leads as shown below.



Procedure

1. Connect the check jig to the CRO-OUT/EXT-IN sockets of the instrument.

2. Enter the system test number [08] (Test level 1) or [10] (Test level 2) and press the Start/Stop key.

   To quit the test, press the Start/Stop key or Auto/Manual key. The instrument returns to the standby mode for entering the system test number.

Check Procedure

Check that the shape of the two printed triangular waveforms are the same and there is no delay time between them.

Possible Source of Problem	Corrective Action
Faulty ECG control board.	Replace the ECG control board.

System Setup Initialization

This is used to reset all the system settings to the factory initial settings.

NOTE

The following settings are not reset to the factory initial settings even if the instrument is initialized.

- **date and time***
- **recording resolution setting***
- **cue mark position***
- **elapsed time**
- **saved ECG data**
- **display language****
- **hospital name****
- **direct/modem connection****
- **local language font**

For settings marked with *, refer to the following corresponding subsection in this section; for settings marked with **, refer to "Changing Settings Before Measurement (System Setup Screen)" in the operator's manual.

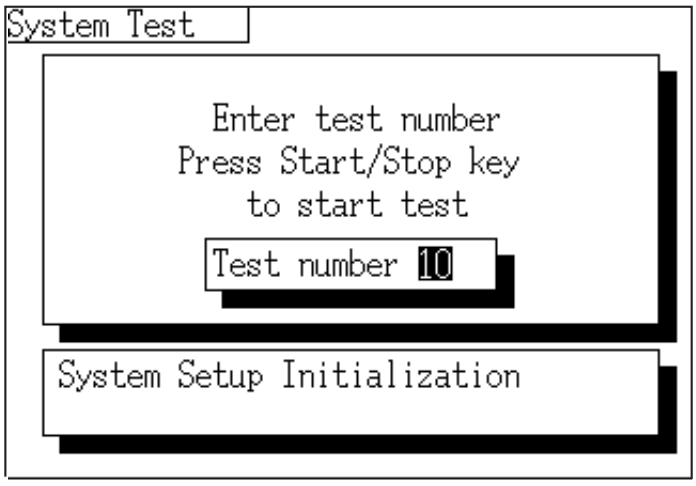
Procedure

Enter the system test number [10] (Test level 1) or [12] (Test level 2) and press the Start/Stop key.

If the initialization is completed, a "System Setup Initialization" message appears with one "bing bong" alarm sound and the instrument returns to the stanby mode for entering the system test number.

Refer to the operator's manual for the factory initial settings.

Following is the LCD display after the system has been initialized.



ECG Findings List Recording

This is used to print out the list of all ECG findings used for the instrument. The instrument informs you of the ECG finding as a result of the ECG interpretation when analyzing the ECG.

Procedure

Enter the system test number [11] (Test level 1) and press the Start/Stop key.

When the list is completely printed, one “bing bong” alarm sound is generated and the instrument returns to the standby mode for entering the system test number.

To cancel printing the list, press the Start/Stop key or Auto/Manual key. The instrument returns to the standby mode for entering the system test number.

Recording Resolution Setting

This is used to adjust the thermal head recording resolution after the thermal head is replaced with a new one or when the printout is not clearly, evenly and completely printed.

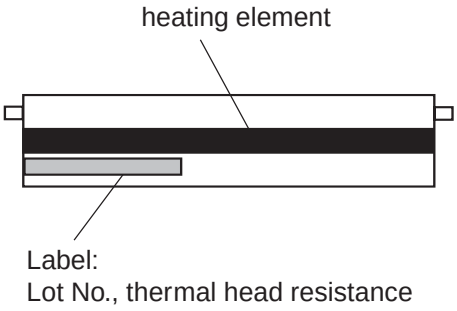
Normally, the resistor value of the heating element on the thermal head is a specific value which varies from thermal head to thermal head. Even if the same energy is applied to the thermal head, the recording quality varies due to the difference of the thermal head resistor value. Therefore, adjusting the thermal head recording resolution is required to evenly print regardless of the thermal head resistor value.

Do the following procedure to automatically adjust the thermal head recording resolution.

Procedure

1. Call up the System Test Level 2.

2. Enter the system test number between [41] and [48] according to the thermal head resistance value



Thermal head resistance	System set No.
935 to 990 Ω	Recording resolution setting1 [41]
991 to 1045 Ω	Recording resolution setting2 [42]
1046 to 1100 Ω	Recording resolution setting3 [43]
1101 to 1155 Ω	Recording resolution setting4 [44]
1156 to 1179 Ω	Recording resolution setting5 [45]
1180 to 1232 Ω	Recording resolution setting6 [46]
1233 to 1265 Ω	Recording resolution setting7 [47]
1266 Ω or more	Recording resolution setting8 [48]
Current setting	Recording resolution setting [49]

3. Press the Start/Stop key.

4. Turn the power off. (Test level 2) and press the Start/Stop key.

Date and Time Setting

The date and time of the instrument are set in the System Setup mode. In the System Setup mode, you can also set the entire system settings of the instrument which determines the operation conditions of the instrument. Refer to the operator's manual for details.

The date and time is backed up with the lithium battery in a real time clock IC on the ECG control board. The life time of the lithium battery is about 7 years. When the "Error 09" error message appears and the date is reset to January 1, 1980, the lithium battery is completely discharged. Replace the ECG control board and set the date and time.

Setting the Date and Time

1. Call up the System Setup mode
   1) If the power is on, turn it off.

NOTE

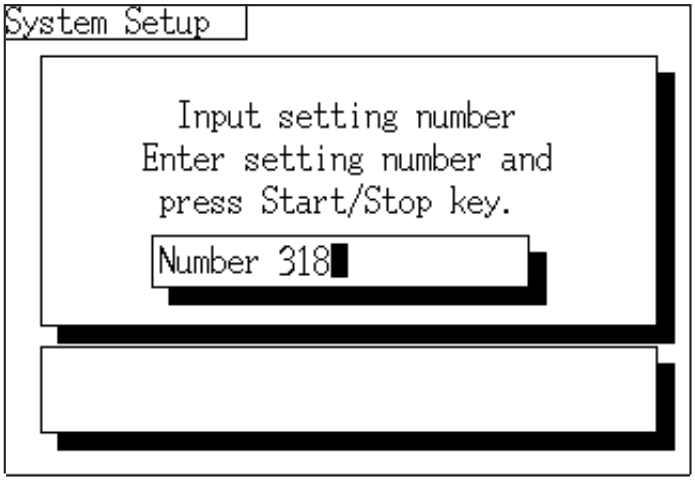
Release the Feed/Mark key immediately after the instrument starts printing. If you continue to hold the Feed/Mark key for more than 15 seconds, the instrument recognizes that the Feed/Mark key is short-circuited and prints the system information "Error 05" at the end of printing.

   2) Press the Power key while pressing the Copy/CAL key. Hold the Copy/CAL key until the instrument begins to print the list of the system setup settings. The System Setup mode is called up.

      To cancel printing the list, press the Start/Stop key.

2. Enter a 3-digit number to call up the stanby mode for entering the new numbers for year, month/date, hour/minute or second, respectively. Refer to the "Entering the System Test Number" in this section for entering the numbers.

   Following is the LCD screen when the year setting mode is called up.



Year
Enter the system setup number [318].

Month/date
Enter the system setup number [319].

Hour/minute
Enter the system setup number [320].

Second
Enter the system setup number [322].

To cancel the entered number, press the Auto/Manual key.

NOTE
You cannot enter numbers for "second" setting.

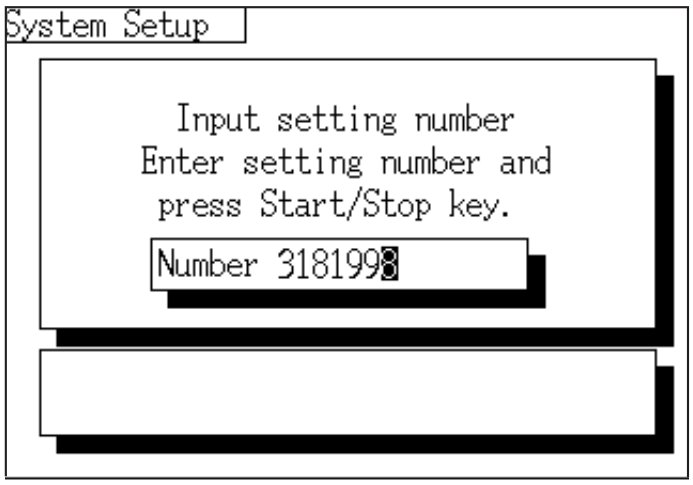
3. Enter a 4-digit number to enter the new numbers of the year, month/date or hour/minute. The range of the number which is possible to enter is as follows:
Year
[1980] to [2079]

Month/date
[0101] to [1231]

Hour/minute
[0000] to [2359]

To cancel the entered number, press the Auto/Manual key.

Following is the LCD screen when the year "1998" is entered.

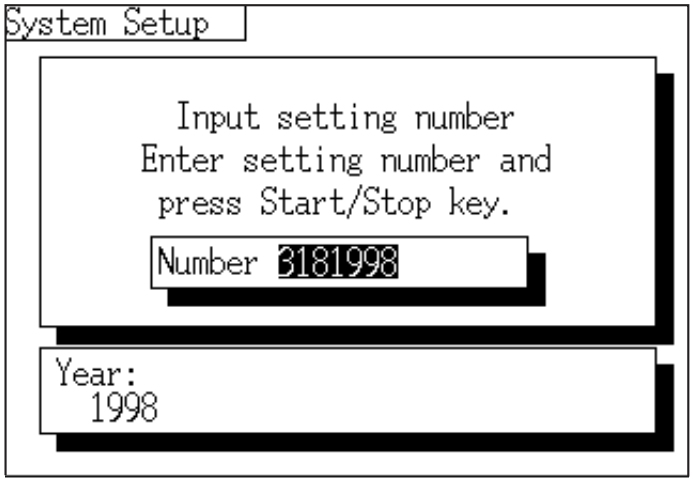


NOTE

- **If the Start/Stop key is pressed in the "second" setting mode, the second is reset to "00" seconds and the instrument starts working from "00" seconds.**
- **If the power of the instrument is turned off before the Start/Stop key is pressed, the newly entered numbers are invalid.**

4. Press the Start/Stop key to save the new numbers. The newly entered numbers are automatically printed.

   Following is the LCD screen when the year "1998" is saved.



   If you entered an unspecified number, 8 repeating "pips" alarm sound and the "Invalid number. Please re-enter number" error message is displayed.

   To re-enter the system test number, do either of the following:
   - Delete the previously entered number by pressing the Auto/Manual key.
   - Enter the system test number by overwriting the previously entered number.

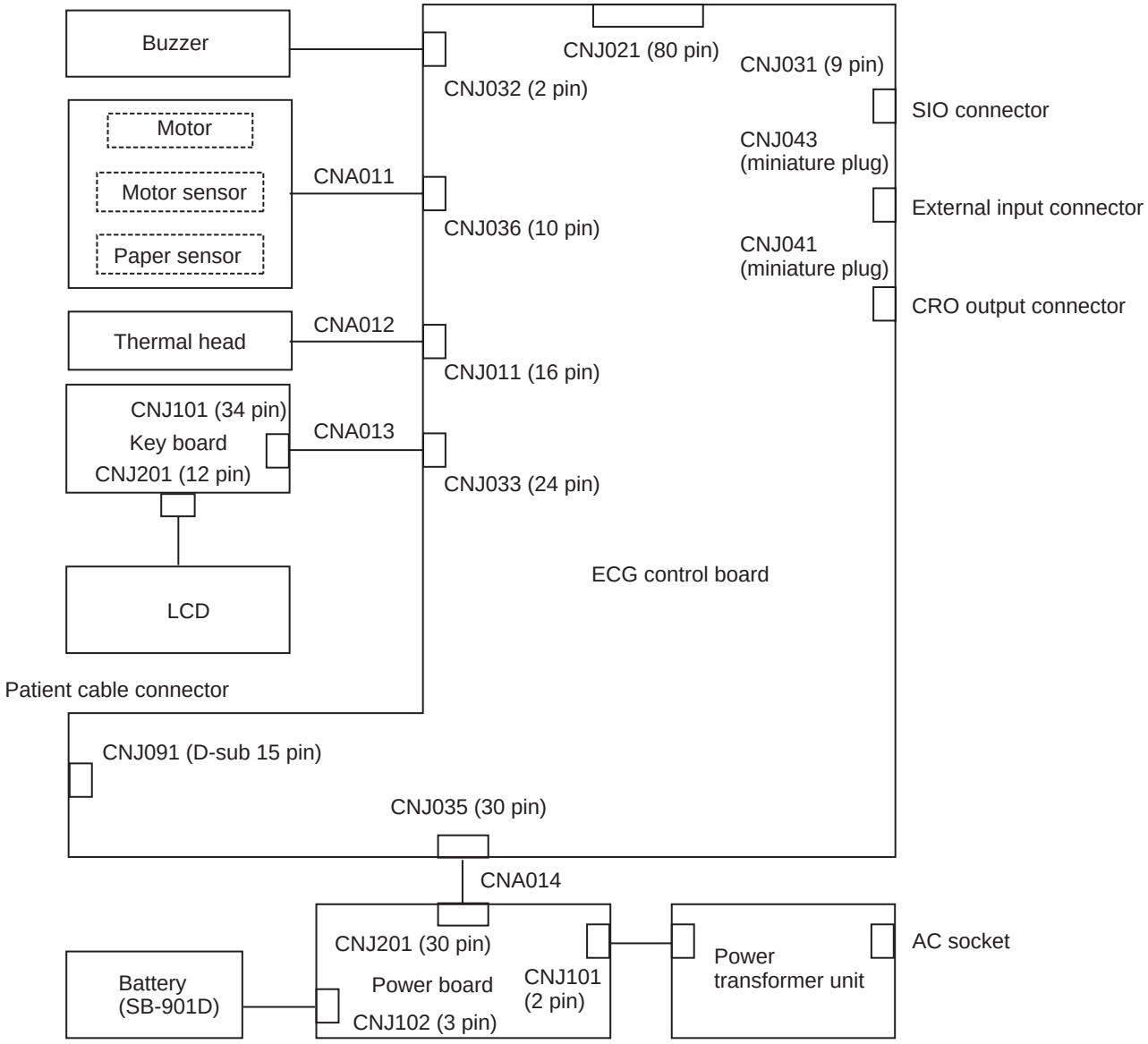
5. Repeat steps 2 to 4 to enter the new numbers for the other settings.

6. Turn the power of the instrument off to exit the System Setup mode.

Section 5 Board/Unit Description

Block Diagram 5.1
Power Unit 5.2
ECG Control Board 5.2

Block Diagram



Power Unit

The Power unit consists of the power source, battery charging and control circuits. The Power unit uses the switching regulation method to produce the power required for the instrument.

- +5 V for digital circuits
- +12 V for analog circuits
- +24 to 30 V for thermal head

ECG Control Board

The ECG Control board consists of the following components:

Component	Description
CPU:	MC68EC020 (Operating frequency: 25 MHz)
ROM:	For system software, 2 MB
DRAM:	Main memory, 4 MB
Flash memory:	16 MB
Real time clock:	with 140 B SRAM and back-up battery (lithium battery)
Timer:	1 ms timer
	Interrupt request signal ON/OFF: selectable
	Operation mode: fixed
Serial interface:	Equivelent to RS-232C, 1 channel
	Baud rate: 2,400 to 115,200 bps selectable
Speaker circuit:	Beep sound, Sound by noise generator
Interrupt request:	Auto-vector method
Interface:	To ECG input section
Recorder:	
LCD:	
Controller:	For keyboard
A/D converter:	

Section 6 Disassembly

Before You Begin 6.1
Warnings and Cautions 6.1
Required Tools 6.1
Cable Connection 6.2
Removing the Upper Casing 6.4
Removing the Magazine and Recording Paper 6.4
Removing the Battery Pack 6.4
Removing the Upper Casing 6.4
Removing the Thermal Head and Motor Assy 6.5
Removing the Thermal Head 6.5
Removing the Motor Assy 6.6
Removing the ECG Control Board 6.6
Removing the Power Board 6.8
Removing the Power Board 6.8
Replacing the Power Fuse and Battery Fuse 6.9
Removing the Key Board and LCD Unit 6.10

The procedures in this section tell how to remove, replace and install major components in the instrument.

Before You Begin

Removing, replacing and installing major components should be done by qualified service personnel.

Warnings and Cautions

WARNINGS

- **To avoid the possibility of injury to yourself or damage to the instrument, do not install or remove any component or change switch settings while the power is on. Turn the power off and wait 10 minutes before installing to or removing any component from the instrument.**
- **To avoid accidental discharge of static electricity which could damage the instrument components, use a wrist ground strap when installing or removing any component of the instrument.**

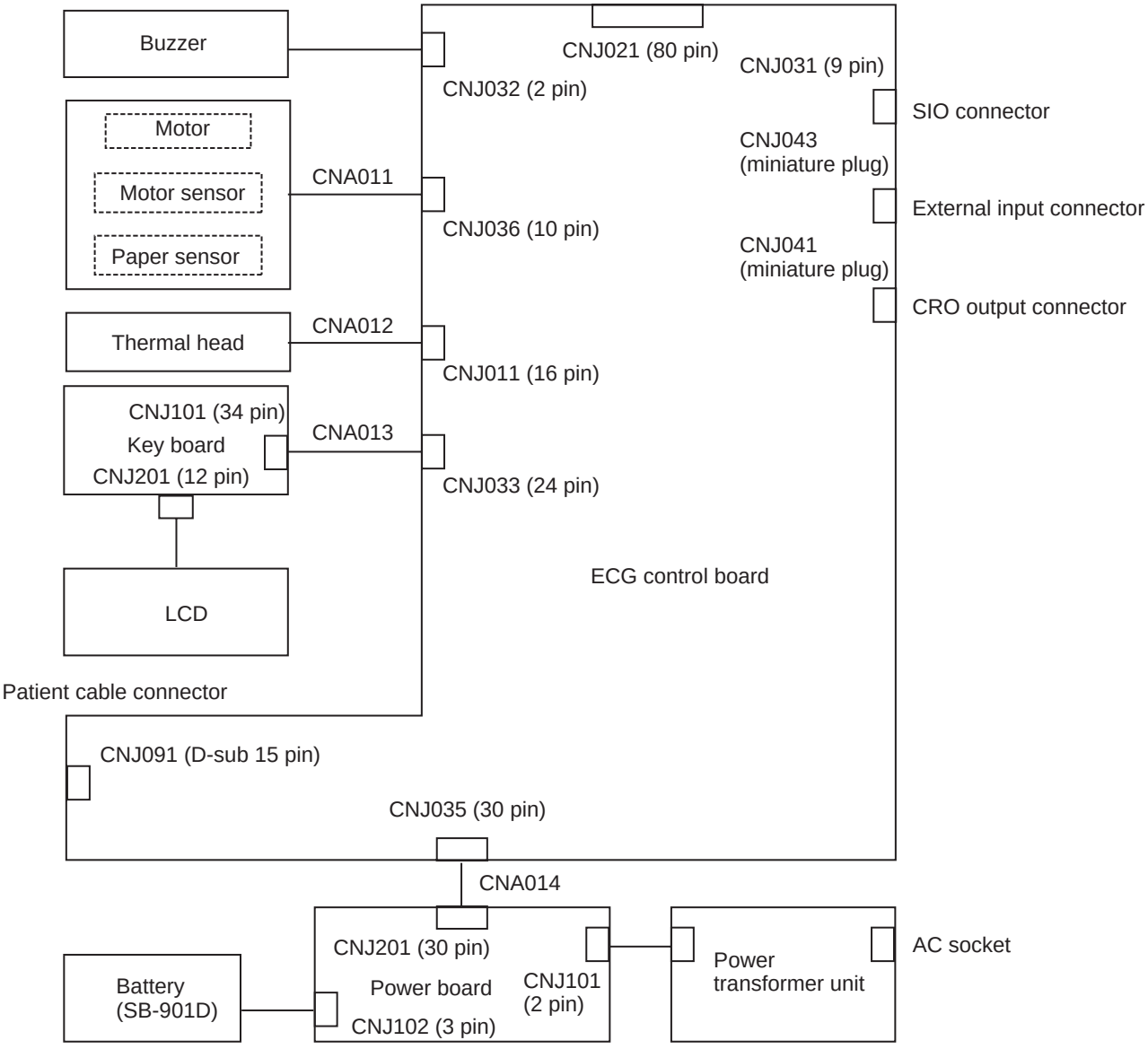
CAUTIONS

- **Before connecting or disconnecting any cables, turn off the instrument, unplug the AC power cord from the instrument and remove the battery pack.**
- **Fuses cut off the power when an abnormality occurs in the instrument. Eliminate the malfunction before replacing the fuse. Use the correct fuse only. The fuse rating is shown on the holder.**
- **Removal and replacement of any component in the instrument should be done by qualified service personnel.**
- **Use only parts recommended by Nihon Kohden to assure maximum performance from your instrument.**

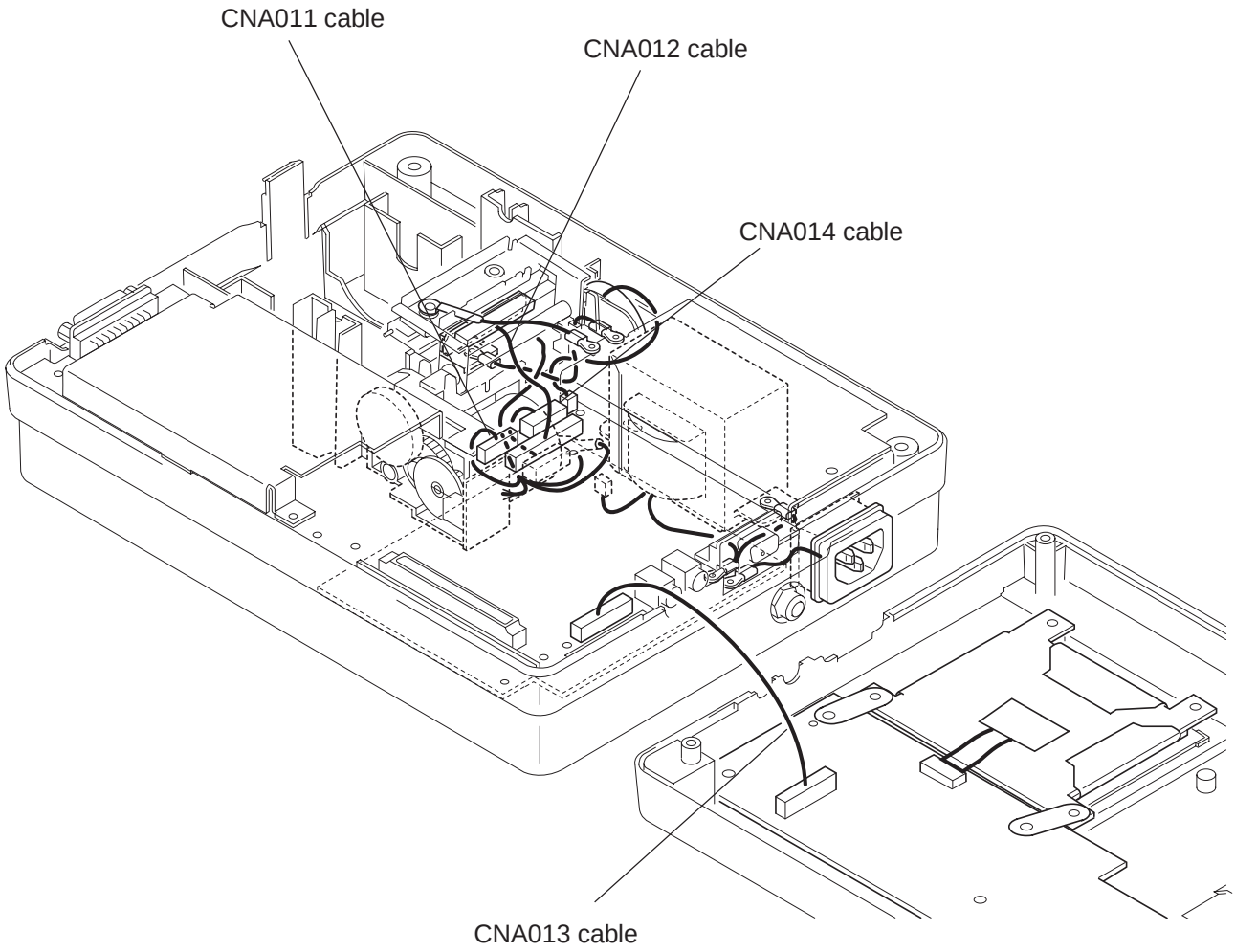
Required Tools

- Anti-static bench mat
- Wrist ground strap
- Phillips screwdriver (insulated type)
- Flat-blade screwdriver (insulated type)
- Hex (Allen) wrench or hex keys
- Hex driver
- Tweezers

Cable Connection



No.	Code No.	Description
CNA011	08SK3.670.00216A	ZHR-10 L=120, 90, 130 between motor assy and ECG control board
CNA012	08SK3.670.00181B	PHR-16 L=80, between thermal head and ECG control board
CNA013	08SK3.670.00172A	PHDR-24VS (W=100), between key board and ECG control board
CNA014	08SK3.670.00199B	SHDR-30V-S-B (W=60), between power board and ECG control board



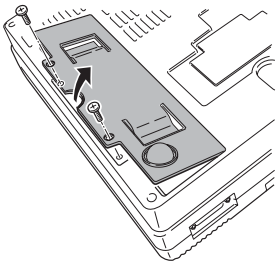
Removing the Upper Casing

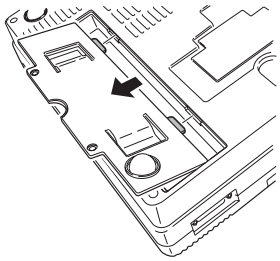
Removing the Magazine and Recording Paper

1. Press down the magazine release button to open the magazine.
2. Remove magazine and recording paper into the magazine.

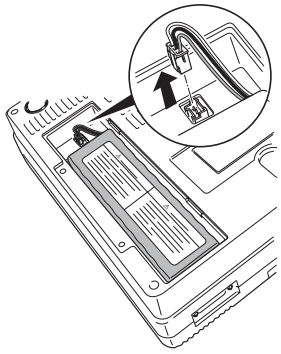
Removing the Battery Pack

1. Remove the two M3 binding head screws from the battery cover.





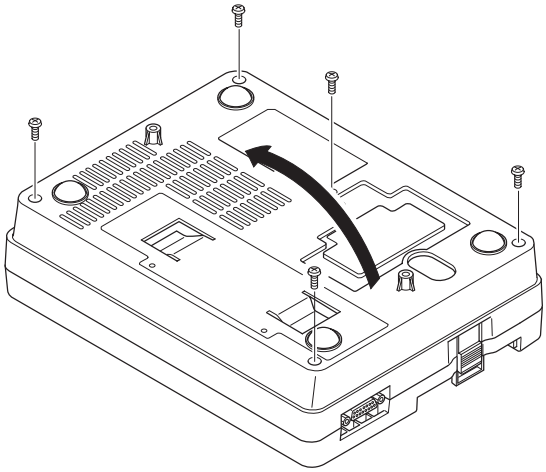
2. Open the battery cover by sliding it up as shown in the figure.



3. Disconnect the battery cable from the battery pack connector..
4. Remove the battery pack from the battery compartment.

Removing the Upper Casing

1. Remove the five M3 binding head screws.



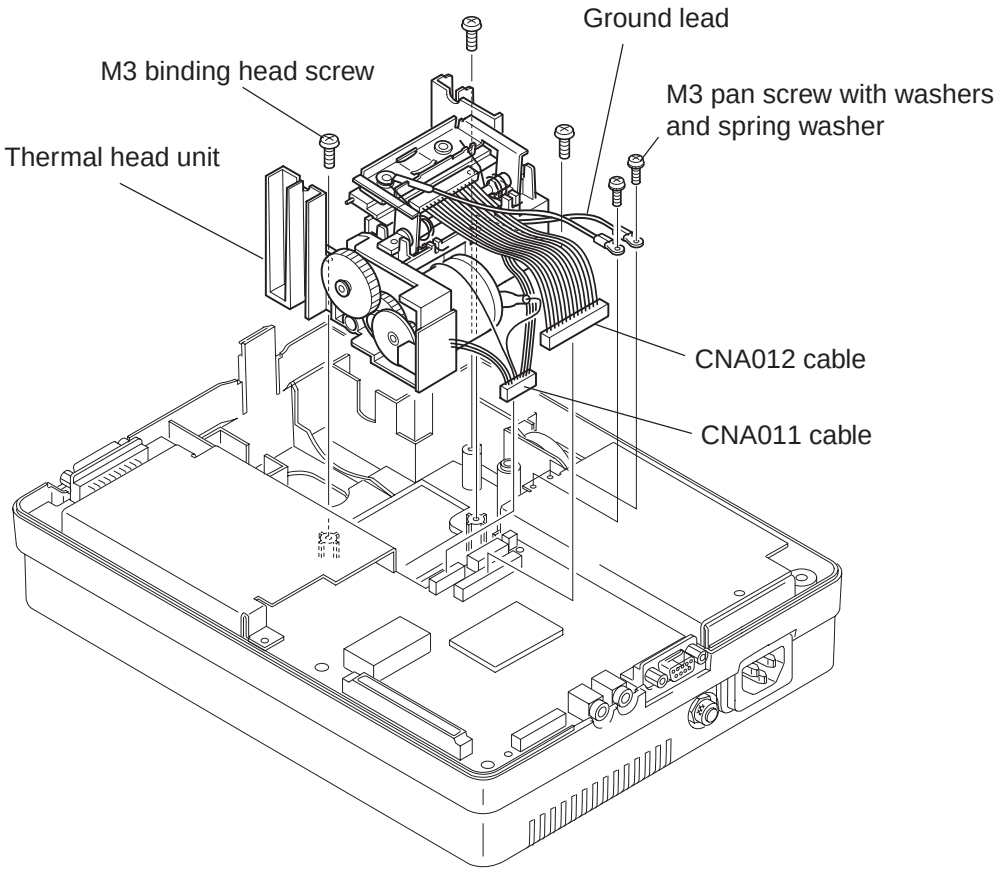
2. Open the upper casing in the direction of the arrow.

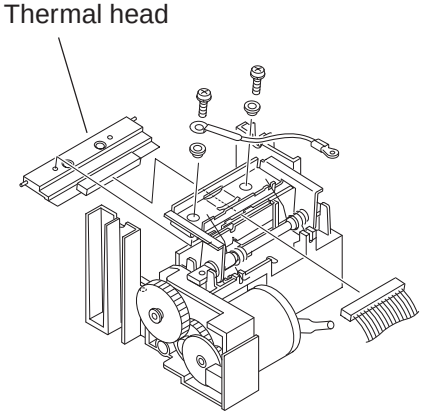
Removing the Thermal Head and Motor Assy

Removing the Thermal Head

1. Remove the battery pack and upper casing from the lower casing. Refer to “Removing the Upper Casing” .

2. Remove the two M3 pan screws with washers and spring washers which fasten the ground leads to the power transformer unit.





3. Disconnect the CNA011 and CNA012 cables from the ECG control board.

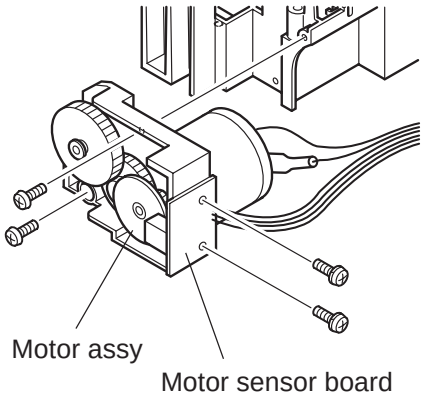
4. Remove the three M3 binding head screws which fasten the thermal head unit to the lower casing and remove the thermal head unit.

5. Remove the two M3 binding head screws washers which fasten the thermal head to the thermal head unit.

6. Remove the thermal head.

7. Remove the thermal head cable from the thermal head.

Removing the Motor Assy

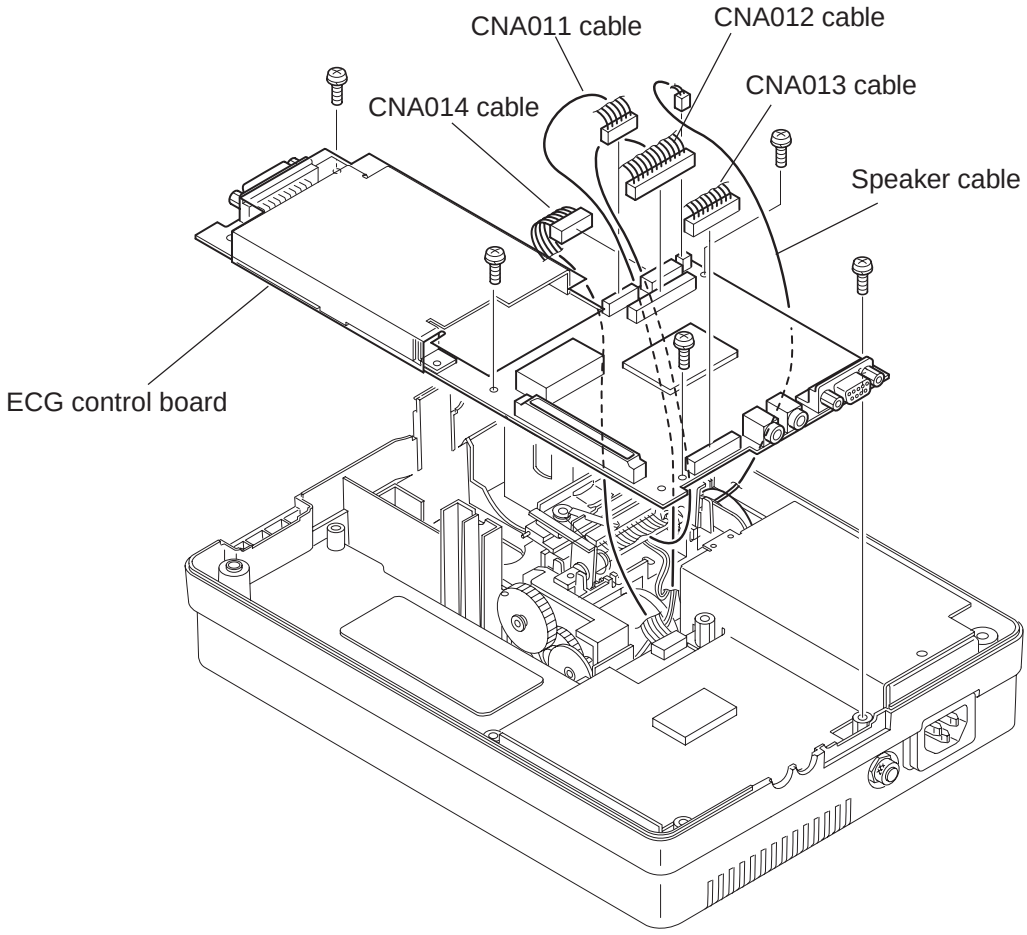


1. Remove the thermal head unit from the lower casing. Refer to step 1 to 6 in "Removing the Thermal Head Unit".
2. Remove the M3 pan screw and remove the paper sensor board.
3. Remove the two M3 binding head screws which fasten the motor assy to the thermal head unit and remove the motor assy.
4. Remove the two M3 pan screws with spring washers which fasten the motor sensor board to the motor assy and remove the motor sensor board.

Removing the ECG Control Board

1. Remove the battery pack and upper casing from the lower casing. Refer to “Removing the Upper Casing” .

2. Disconnect the CNA011, CNA012, CNA013, CNA014 and speaker cables from the ECG control board.



3. Remove the six M3 pan screws with washers which fasten the ECG control board to the lower casing and remove the ECG control board.

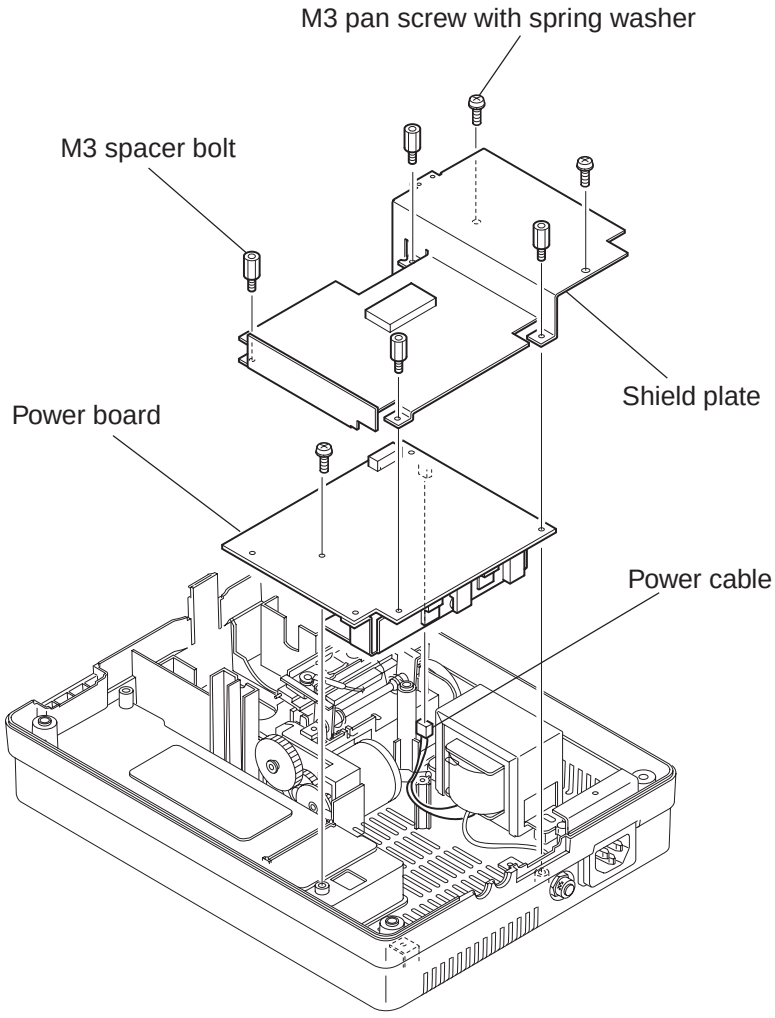
Removing the Power Board

Removing the Power Board

1. Remove the battery pack and upper casing from the lower casing. Refer to “Removing the Upper Casing” .

2. Remove the ECG control board. Refer to “Removing the ECG Control Board”.

3. Remove the two M3 pan screws with washers and four M3 spacer bolts which fasten the shield plate to the lower casing and remove the shield plate.

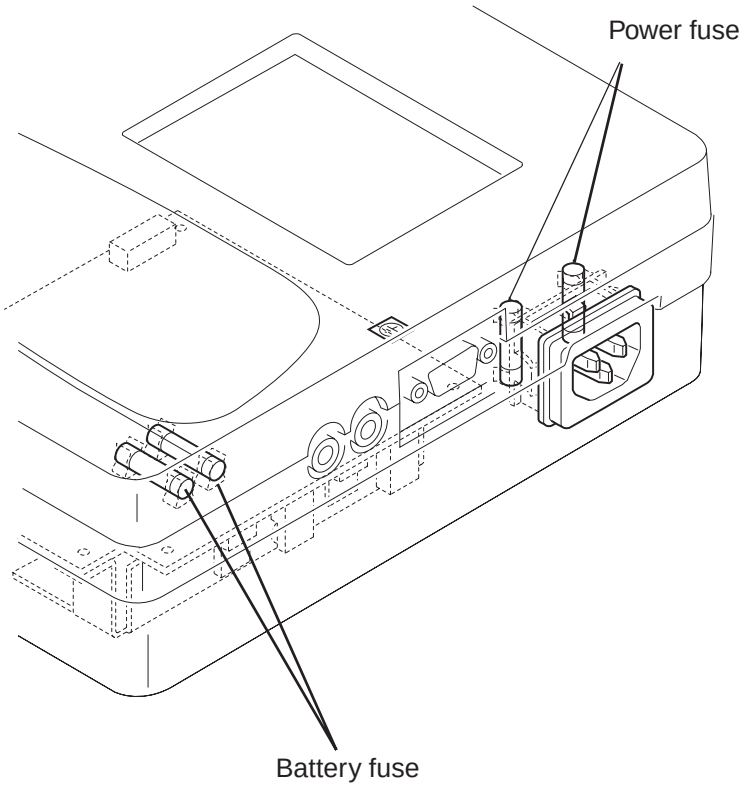


4. Remove the M3 pan screw with washer which fastens the Power board to the lower casing and remove the power unit.

5. Disconnect the power cable from the power board.

Replacing the Power Fuse and Battery Fuse

1. Remove the power board from the lower casing. Refer to “Removing the Power Board”.
2. Turn the power board over.
3. Replace the battery fuses with a new one.
4. Replace the power fuse with a new one.



Power fuse

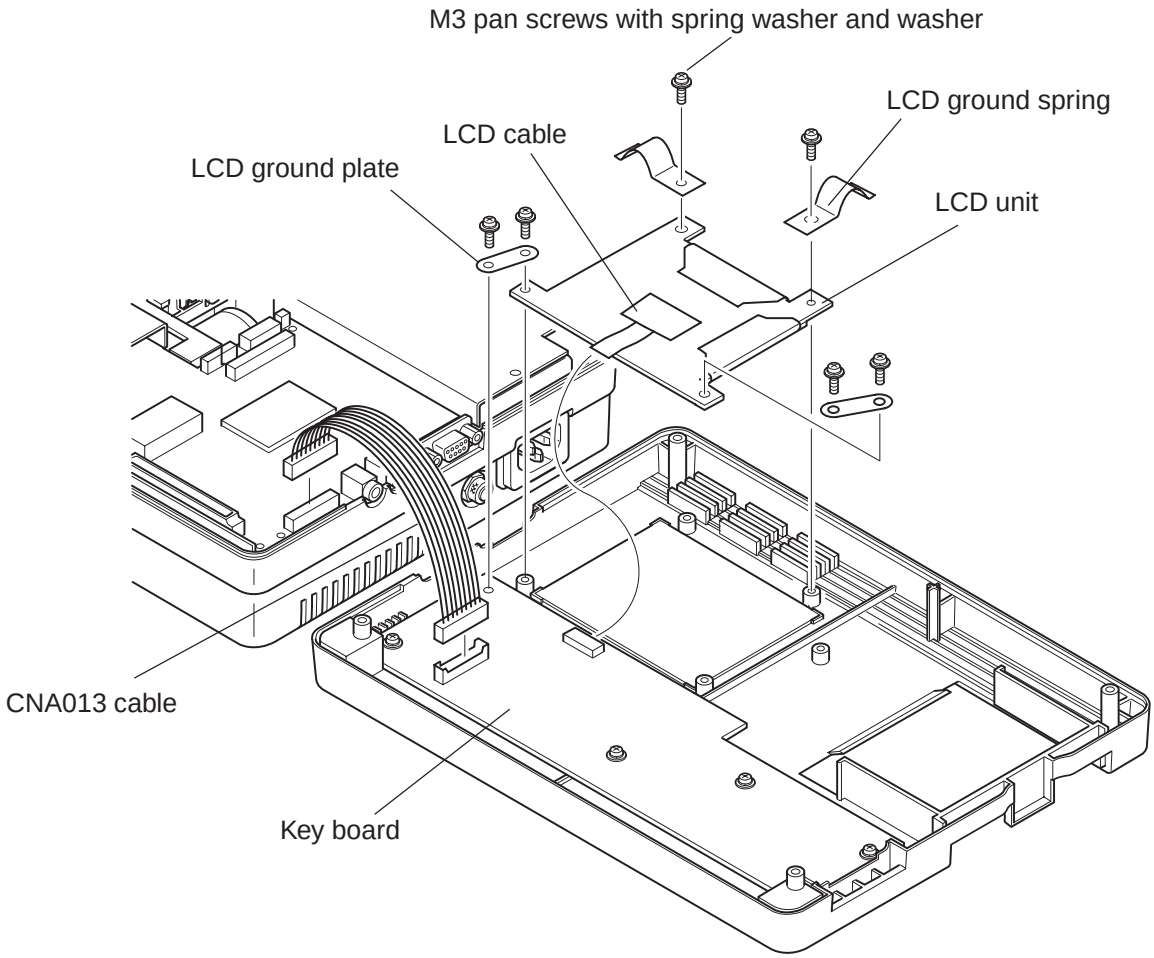
	Code No.	Description
ECG-9620L/M/N/P:	274035	218.250 (0.25 A)
ECG-9620S/T/U:	104665	218.500 (0.5 A)

Battery fuse

	Code No.	Description
F101:	540657	239.001 (1 A)
F102:	323241	218.008 (8 A)

Removing the Key Board and LCD Unit

1. Remove the battery pack and upper casing from the lower casing. Refer to "Removing the Upper Casing".



2. Disconnect the CNA013 cable from the key board.

3. Release the connector lock and disconnect the LCD cable from the key board.

4. Remove the six M3 pan screws with spring washers and washers which fasten the LCD unit to the upper casing and remove the LCD unit, two LCD ground spring and two LCD ground plates.

5. Remove the four M3 pan screws with spring washers and washers which fasten the key board to the upper casing and remove the key board.

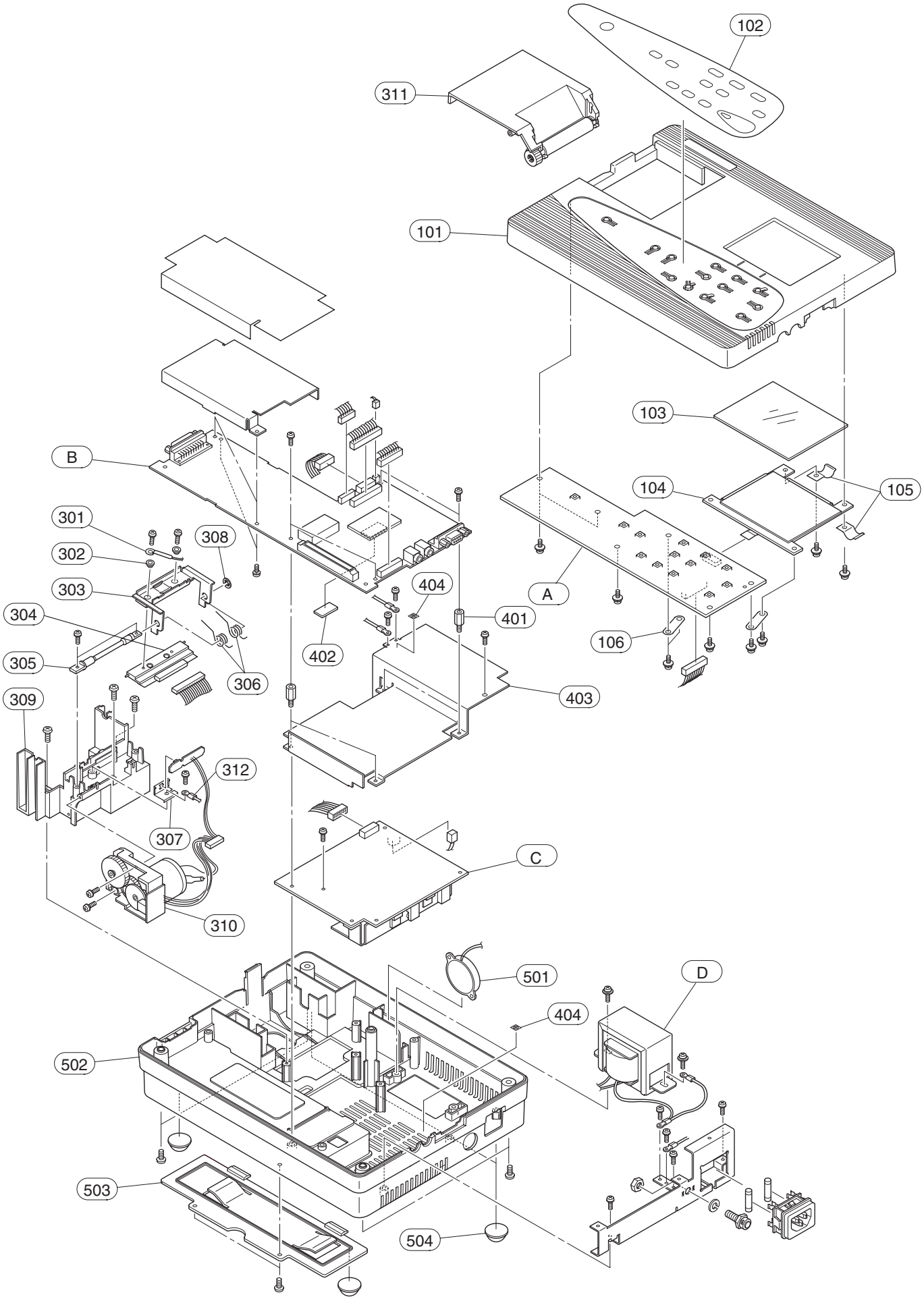
Section 7 Replaceable Parts List

Instrument 7.2

When ordering parts or accessories from your nearest Nihon Kohden Corporation distributor, please quote the NK code number and part name which are listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use Nihon Kohden parts and accessories to assure maximum performance from your instrument.

Instrument

Index	Code No.	Qty	Description
101	08SK8.074.00075	1	ECG-9620 Upper casing
102	08SK8.081.00316	1	Operation panel
103	08SK8.080.00086	1	LCD filter
104	08SK2.929.00047	1	LCD unit, MR604WBE11
105	08SK8.048.00032	2	LCD ground spring
106	08SK8.387.00227	2	LCD ground plate
302	08SK8.223.00066	2	Head collar bearing
303	08SK8.038.00088	1	Thermal head bracket
304	08SK3.878.00046	1	Thermal head, KYT-56-8MPP1-SKH
305	08SK8.300.00099	1	Thermal head shaft
306	08SK8.387.00031	2	Thermal head spring
307	08SK8.387.00218	1	Paper sensor board ground plate
308	107029	1	E ring, E-50
309	08SK8.072.00032	1	Thermal head unit base
310	RHC-00041	1	Motor assy
311	RHC-00042	1	Magazine assy
401	08SK8.615.00089	4	Spacer bolt, L8
402	08SK7.061.00082	1	Heat sink seat
403	08SK8.610.00031	1	Shield plate
404	08SK8.807.00906	2	Protective ground label
501	08SK5.846.00014	1	Speaker assy
502	08SK6.116.00025	1	ECG-9620 lower casing
503	08SK8.080.00095	1	Battery cover
504	08SK8.085.00054	4	Rubber foot
A	UTC-0006	1	Key board
B	UTC-0007	1	ECG control board
C	UTC-0008	1	Power board
D	RKC-0001	1	Transfer Assy (220 V) for L and P version
	RKC-0002	1	Transfer Assy (230 V) for M version
	RKC-0003	1	Transfer Assy (240 V) for N version
	RKC-0004	1	Transfer Assy (110 V) for S version
	RKC-0005	1	Transfer Assy (120 V) for T version
	RKC-0006	1	Transfer Assy (127 V) for U version


102
311
101
103
B
104
105
301
308
302
303
404
304
401
A
106
305
306
402
403
309
312
307
C
310
501
D
404
502
503
504

Section 8 Connector Pin Assignment

Connector Pin Assignment 8.1
Attaching the Ferrite Core 8.1
EXT-IN Connector 8.2
CRO-OUT Connector 8.2
SIO Connector 8.2

Connector Pin Assignment

CAUTION

- **When connecting an external instrument to connectors marked with ⚠, the external instrument and this cardiograph must be connected according to the IEC60601-1-1 "Medical electrical equipment - Part 1-1: General requirements for safety - Collateral standard: Safety requirements for medical electrical systems". Failure to follow this warning may cause electrical shock to the patient and operator.**
- **When the cardiograph operates on battery power and large leakage current is input from the connected external instrument, ground the cardiograph or use an isolation transformer for the external instrument. Failure to follow this caution may cause electrical shock to patient and operator.**

Attaching the Ferrite Core

NOTE

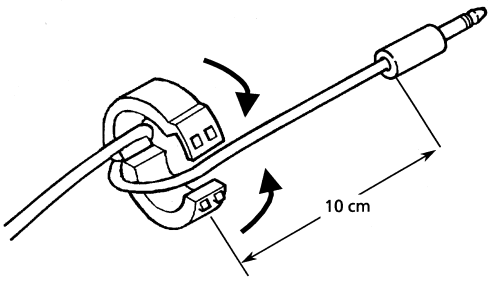
When connecting an external instrument to the following connecters, an unwanted radio frequency signal is generated from this connection. To reduce this unwanted radiofrequency signal, attach the optional ferrite core to the cable of the external instrument.

Connector	Ferrite core model	Code No.	
EXT-IN	RI-14-28-6	493182	Wrap the cable once around the ferrite core.
CRO-OUT	RI-14-28-6	493182	Wrap the cable once around the ferrite core.
SIO	SEC-8	361814	-

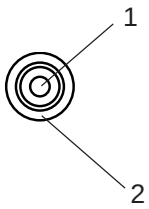
Example of Wrapping

NOTE

Attach and fix the ferrite core near the connector of the cable that connects to the cardiograph.



EXT-IN Connector



Unit side: SG-8036 (Code No.: 273446)
Cable side: P-112D 3.5mm φ miniature plug (Code No.: 606907)

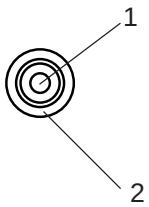
Pin No.	Signal
1	EXT-IN 1
2	GND

Input sensitivity: 10 mm/0.5 V, input impedance 100 kΩ or more

CRO-OUT Connector

CAUTION

Do not use the output signal from the output connector for a synchronization signal such as the synchronized cardioversion signal. There is a time delay between the input ECG signal and output signal.

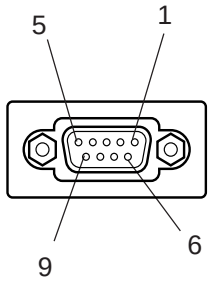


Unit side: SG-8036 (Code No.: 273446)
Cable side: P-112D 3.5 mm φ miniature plug (Code No.: 606907)

Pin No.	Signal
1	CRO-OUT
2	GND

Output sensitivity: 0.5 V/1 mV, output impedance 100 Ω or less

SIO Connector



Unit side: JEY-9S-1A2B (Code No.: 390774)
Cable side: Connector, DE-9P (Code No.: 082625)
Cover, DE-C8-J9-F1-1 (Code No.: 336708)

Pin No.	Signal	Pin No.	Personal conputer
1	Shield	1	Shield
2	TxD	2	TxD
3	RxD	3	RxD
4	RTS	4	RTS
5	CTS	5	CTS
6	DSR	6	DSR
7	GND	7	GND
8	DCD	8 to 19	Not used
9	DTR	20	DTR
		21 to 25	Not used

Pin assignment may depend on the shape of connectors for PCs.
To connect a modem, use a dedicated cable 15 m or shorter.

Manufacturer
NIHON KOHDEN CORPORATION
1-31-4 Nishiochiai, Shinjuku-ku
Tokyo 161-8560, Japan
Phone +81 (3) 5996-8036
Fax +81 (3) 5996-8100

上海维修站
上海市徐汇区南丹路 169 号 新旺大厦 3008 室
电话：021-6469-9016 传真：021-6486-7218

北京维修站
北京市西城区南礼士路甲 3 号 海通大厦 601 室
电话：010-6804-9531 传真：010-6804-7366

广州维修站
广州市环市东路 371～375 号 世贸中心南塔 1809 室
电话：020-8761-2726 传真：020-8761-1135

沈阳维修站
沈阳市和平区太原北街 20 号
电话：024-2383-2557 传真：024-2340-2565

成都维修站
成都市一环路西二段 17 号 华立大厦 420 室
电话：028-8779-6330 传真：028-8773-6236

武汉维修站
武汉市汉口解放大道 1087 号 梅园大厦 413 室
电话：027-8360-2368 传真：027-8360-2478

NIHON KOHDEN AMERICA, INC.
90 Icon Street, Foothill Ranch, CA 92610, USA
Phone +1 (949) 580-1555
Fax +1 (949) 580-1550

EC REP European Representative
NIHON KOHDEN EUROPE GmbH
Raiffeisenstrasse 10
D-61191 Rosbach, Germany
Phone +49 6003 827-0
Fax +49 6003 827-599

NIHON KOHDEN ITALIA S.r.l.
Via San Tomaso 78
I-24121 Bergamo, Italy
Phone +39 035 219 543
Fax +39 035 232 546

NIHON KOHDEN IBERICA S.L.
C/ Ulises 75A
E-28043 Madrid, Spain
Phone +34 917 161 080
Fax +34 913 004 676

NIHON KOHDEN SINGAPORE PTE LTD
70 Shenton Way, #14-05 Marina House
Singapore 079118
Phone +65 6224-6700
Fax +65 6224-6216

The model and serial number of your instrument are identified on the rear or bottom of the unit. Write the model and serial number in the spaces provided below. Whenever you call your distributor concerning this instrument, mention these two pieces of information for quick and accurate service.

Model _____ **Serial number** _____

Your Distributor